THE AMERICAN GAS LIGHT JOURNAL

REDMANKENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LXIV.—No. 22. Whole No. 1,095. | NEW YORK, MONDAY, JUNE 1, 1896. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

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Published on each Monday of the year, at No. 32 Pine Street, New York.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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BRIEFLY TOLD.

THE RESULT AT CHATTANOOGA.—Our mention last week of the Chattanooga meeting of the Western Gas Association was so thorough that little remains to be said now regarding it which has the merit of newness to commend it. The meeting was in all respects a success, no matter from what point of view the examiner may regard it. The weather was, on the whole, propitious, although the thermometer was inclined to the high scale; the attendance was numerous and representative; the hotel accommodations and the meeting room were not to be found fault with; the Committee of Arrangements were fully up to their duties; the officers directed the proceedings with ability and tact; the delegates were pertinacious in their attendance on the business sessions; the technical matter put before them was admirable for quality and sufficient in quantity; and the social features afforded fine opportunity for satisfactorily whiling through and among the hours of ease. With all that said, really nothing else remains to be said, in writing down the history of the Western's 19th convention, to show whether it was a success or failure, and so it remains merely to voice our congratulations to ex-President Littleton that the culmination of his office-bearing in the service of the Western Association was in nice accord with the results of his many years of well-arranged work carried on as the Association's Secretary and Treasurer.

MR. S. M. HIGHLANDS DECLINED PROMOTION.—When the report of the Committee on Nomination of Officers for the current year in the Western Association was presented, some surprise was occasioned by the fact that Mr. S. M. Highlands, of Clinton, Iowa (last year elected to the position of Second Vice-President, and who normally would this year have been named First Vice-President), had not been selected for promotion in accordance with the custom of the Association. This surprise was quite understandable, for the Committee, in making their report, failed, through inadvertence, to specify that, some days in advance of the meeting, President Littleton received a letter from Mr. Highlands, in which, in the most positive terms, that gentleman declined to allow his name to be considered for promotion to the First Vice-Presidency. We are not in possession of the reasons that led Mr. Highlands to his refusal, and, in common with the Association, we must accept them, whatever they were, as all-convincing; but this acceptance does not debar us from expressing regret that the course followed by him puts a well qualified man from going on to the highest honor that the Association could bestow.

AN APPEAL FROM THE PACIFIC COAST GAS ASSOCIATION.—It is with pleasure, somewhat tempered by disquiet, that we give prominence to the appended circular letter, issued by Mr. John A. Britton, Secretary and Treasurer of the Pacific Coast Gas Association, to the gas men of "The Coast." The pleasure that we have in the presentation springs from the knowledge that such publication may—in fact, likely will—assist Mr. Britton's worthy purpose, and our disquiet over it lies in the fact that such prodding "for the common good" of the Coast Association is at all necessary. However, here is the text of Mr. Britton's communication:

"This is not a circular letter intended for the waste paper basket, but is addressed solely to the gas men of the Association—those having active connection with the works.

"I know that Messrs. Parker and Clements have had something to say to you about "Wrinkles." I know also from my own experience that it is not always possible to present some new or novel idea in the gas line; but I also believe that you have had experiences—some little thing during the year that at the time struck you as being out of the common. It may have been in the character of the soil dug into for the laying of pipe; it may have been in a leaky joint or rusting service, or in some action of electrolysis, some little leak or trouble in the retort house, or with the exhauster or condenser or scrubber, some experience with an opposition company, with water power, or with a new plant.

"These little things don't mean 'Wrinkles' nor would they be worthy of being classed as papers to be read; but in such things there is information that is valuable to the gas man. Such things, I mean, as you would tell another superintendent if you should run across him casually, or if he should visit your works.

"I want to make this proposition of *experiences* a new item in our meetings, and trust that you will think up some and forward them to me. If desired, the location of the company need not be known except to myself.

"For the credit of the Association I would like to have you send me some questions, and send them right away. It strikes me as singular that, where a gas man can get information for nothing, he should be backward about asking for it. You know there are men in the Association who are competent to answer any questions. Now, don't be afraid to ask them.

"To make the meeting of the Association a success there must be interest, and the interest is shown by just such things as I have mentioned. Won't you, when you get this, start in to make this meeting a success by sending me some experiences or some questions?—JOHN A. BRITTON, Secretary."

LOOKING over the Britton circular again, we find that we will have to take back our introductory remarks, in so far as they relate to any cause for disquiet on our part because of Mr. Britton's appeal, for our last look at it brought out clearly enough that he intends to start an "Experience Report," as an entirely new feature of Association proceedings. That he may be completely successful in the trial is our wish.

NOTES.—The "Beefsteak Club" of this city recently had a feast on planked shad, cooked and served at No. 1,387 Broadway. The *chef* was none other than the famous "Nick." Engel, and the rosy cheeks of "Harry" Weiskittel, of Baltimore, Md., who shared in the festivities, took on a deeper hue when Engel blurted out, "Give me a conscientious, well-developed shad, a nicely seasoned hickory plank, and a Fire King gas stove, and I'll make those Delaware and Potomac river plankers look like amateurs."——At the annual meeting of the Atlantic City (N. J.) Gas and Water Company resolutions of regret over the death of Mr. Hamilton Disston (a former member of the Board of Directors) were adopted. A dividend of $1 per share was declared and the following officers were elected: Directors, Jos. A. Barstow, J. H. Borton, T. K. Reed, J. E. Mehrer, F. Hemsley, J. B. Champion, S. Bradley, J. Roberts, W. L. Elkins, P. A. B. Widener, G. S. Graham, Jas. McManes and C. Evans; President, J. A. Barstow; Secretary, T. K. Reed; Treasurer, Joseph Horton.——According to the report of Mr. T. D. Tinsley, during his first year of the administration of the affairs of the Macon (Ga.) Gas Light and Water Company, the Company has prospered. The surplus for the year is shown to be $15,732.68. The receipts from gas sales were $40,037.46; from water sales, $48,943.30; from sales of electric current, $29,631.62, or a total of $118,612.38. A considerable amount of money was spent on betterment account during the twelvemonth.——The proprietors of the New Bedford (Mass.) Gas and Electric Light Company have ordered that on and after July 1st the gross price to consumers will be $1.50 per 1,000 cubic feet, instead of $1.80 as at present. The usual reduction of 10 per cent. will be granted on all ordinary bills paid before the tenth day of the month in which they are presented. All bills showing a monthly consumption of 4,000 cubic feet or over will be discounted at the rate of 25 per cent.——A meeting of the shareholders of the Perth Amboy (N. J.) Gas Light Company is called for the 4th inst., at which will be considered a proposition to issue preferred stock to the amount of $15,000.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.]

NINETEENTH ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

HELD AT LOOKOUT INN, LOOKOUT MOUNTAIN, CHATTANOOGA, TENN., MAY 20TH AND 21ST, 1896.

FIRST DAY—MORNING SESSION.

The Association met at 10 A.M., Wednesday, May 20th, 1896, the President, Augustus W. Littleton, of Quincy, Ills., in the Chair.

AN ADDRESS OF WELCOME.

The President—Gentlemen, I take great pleasure in introducing the Hon. Henry Clay Evans, of Chattanooga, who has kindly consented to "come up the hill," and give us a short speech of welcome. (Applause.)

Mr. Evans—Mr. President, Ladies and Gentlemen of the Western Gas Association: On behalf of the local committee I am requested to say a word in welcoming this great Association to Chattanooga. I am informed that we have the honor of having you meet here for the first time south of the Ohio river. We take this as a great compliment; and we take it as a compliment, Mr. President, that you should name Chattanooga as your place of meeting. We take it also as a great compliment, and at the same time appreciate it as an expression of your good business judgment, that you have selected this Inn, which is *above* all others, as your place of stopping, and for holding your business meetings. We are glad to welcome you. You meet on historic ground—on Lookout Mountain; and you will have the pleasure of visiting Chickamauga and the surrounding hills. This is sacred ground, made historic by Americans, both of the South and of the North. We all join in welcoming you, not only as an Association, but as individuals. It is within the recollection of people now living in Chattanooga when this country was inhabited by Indians. Within the memory of citizens now living in Chattanooga, Lookout Mountain, the valleys below, and the surrounding hills and hilltops were in the possession of the Cherokee Indians. If you go to the brow of the mountain, in front of this hotel, and look off upon the valleys and the hills, you may view a magnificent prospect—although to-day, as it is cloudy, you may have to draw upon your imaginations a little, for it seems that your visit has brought us the much needed rain and cooler weather; but we had intended, and have it laid out on the programme, to give you a very warm reception. We will give you a kindly reception under all circumstances. We want to thank you, Mr. President, for bringing with you this weather that we have needed so much; for we now have the promise of rain. If you will step to the brow of the mountain and look upon the amphitheater below, you will overlook many points of great historical interest. Immediately in front of you is St. Elmo, made historic by Augusta J. Evans in her famous novel "St. Elmo." To the east you can see the Tennessee river winding down through the mountains for ten miles or more, until it strikes against the foot of Lookout Mountain, and then rolls by, down past Raccoon Mountain and Walden's Ridge. From a point near this Inn you can overlook the States of Tennessee, Georgia and Alabama; and the patient guide that you may pick up here on the mountain will show you many other States of less importance, according to the amount of your contribution—the greater the contribution the more the States—and from there you can overlook the field of Hooker's famous battle above the clouds. Looking eastward you can see Mission Ridge (Missionary Ridge, as it is usually called), taking its name from the missions that were established here among the Cherokee Indians—the Ridge extending from Rossville northwardly for about eight miles. And from that point you can look over what some of the older gentlemen present may have known, in times past, as Ross Landing, but later called Chattanooga. About four miles south of this is the home of John Ross, the Chief of the Cherokee Indians. From that same point you overlook Chickamauga battlefield—now the great National Military Park, and the first of its kind, I believe, in the world; the first instance of a nation or government buying up a battlefield and converting it into a national military park for the benefit of students of military affairs. So you see that here and hereabouts you tread upon sacred soil. Only a few years ago, and within my recollection, as it was within my observation, the mountains and hilltops here and hereabout bristled with deadly implements of war—with muskets and cannons. The muskets we have endeavored to convert into miners' picks for mining coal—of course, to make gas with; and the cannon we have converted into gas pipe. (Applause.) We have here, in the city of Chattanooga, the Chattanooga Foundry and Pipe Works, one of the most extensive pipe works in the whole country. It

has been suggested that it may ultimately roof in all the valley between Lookout Mountain and Missionary Ridge and convert it into pipe works for the manufacture of gas pipe. They established a large plant here a few years ago, but finding Chattanooga not large enough they went to Bridgeport, Alabama, to build another, and they are now building a third just on the limits of the city of Chattanooga. You will understand they do not claim to put these cannon into the ground, and, by simply removing the breeches, convert them into gas pipes; but they have a method of converting them into gas pipes. As you stroll about from place to place you will have an opportunity to see a few cannons which we have preserved as object lessons for students of military affairs. I will not take up your time longer, Mr. President and Gentlemen, as I know that you want to get down to business early in order to declare a dividend. The local committee have laid out for you, after you have concluded your business sessions of to-day and to-morrow, what we think will prove to most of you an entertaining programme. They propose to take you to the National Military Park of Chickamauga, that you may study the military situation as it was at the time of the great battle. Possibly some of you had the satisfaction of being there then and getting away alive, and you may now have the opportunity of renewing your acquaintance with that battlefield. The government has done much in thisline for Chickamauga, for it purchased some 5,600 acres of land and improved it and made a park of it, and different States have there erected monuments designed to mark the spots where their respective commands did the greatest or the hardest fighting. In that way the battle lines have been marked indicating both the first and second battles. That I believe was a battle where both the North and the South claimed a victory. As some gentleman has said General Rosecrans went down to Lafayette, 25 miles south of here, in order to take Chattanooga, but found it to his convenience and comfort to come back to Chattanooga to stay here for awhile. I am going to risk my reputation by repeating an anecdote that a gentleman told me the other night, and if you ring the chestnut bell over it I will not forgive you. I am mindful of the fact that I am telling it here in this convention of gas manufacturers. He said he dreamed that he had passed over the river, and had landed where gas men do not generally go, according to my understanding, where he found everything in very fine shape; the streets were broad and straight; there were shade trees everywhere, with most beautiful foliage; the streets were all well paved and well lighted—in a way superior, as he said, to anything that he had ever seen in this country—that they were all lighted up with gas in a way superior even to the Brush arc light. He said that instead of the light being put away above the trees and causing dark shadows to fall below, the lights were placed upon the streets about the customary height of our gas lamps, and that they lit the streets every bit as well as electric lights do. He found, on inquiry from his conductor, that these were gas lamps, improved after the style of the Welsbach burner, and designed for out-of-door service. They lit up the streets in the brightest manner, superior even to the Brush light—with no wires in sight, and with no unsightly poles; but lighting up the streets in such a way as to make everything appear very beautiful. He commented upon it to his conductor, and when he had the pleasure of meeting his Satanic Majesty he mentioned this fact to him, whereupon his majesty directed his conductor to take him, on a very highly mounted cycle standing by, around through the parks, showing him beautiful lakes, fine foliage and splendid drives, and he found, upon inquiry, that this motor cycle was run by gas from a gas tank—I suppose it is probably an improvement made by some of you gas gentlemen. He also found that the street cars were propelled by gas motors. And so it was all along the way they passed; everything was in the best of shape. When he returned from the ride he reported to his Satanic Majesty how satisfactorily he had found everything, and told him of the dismal ideas that he had always before had of his domain, but that upon his journey around he had found everything so beautiful, the streets in such splendid condition—there were no unsightly poles, there were no wires for the electric lights, there were no wires strung along for use in propelling the cars, or anything of that kind; and his majesty assured him that everything in his country, such as lighting the streets, propelling the cars, etc., was done with gas. And he said that while it was true in years gone by it was a pretty dismal country, of late years they had had so many gas manufacturers coming to that country that they had improved the condition of affairs very materially. (Laughter.) Thereupon the gentleman said he awoke from his dream. I told him he ought to have known at once that it was a dream, because gas men do not go to that country. I trust, gentlemen, you may have a pleasant visit to our city. We are glad to have you visit us, and shall endeavor to give you of our best. When you have gotten through with your business meetings we want to show you around the country. We have no town lots for sale here. All these hill tops that I have spoken about have been converted into strawberry patches, fruit farms, etc., and are very productive and profitable, and the owners of them do not want to sell any town lots. We can, therefore, offer you a disinterested welcome. We assure you we feel highly complimented with having you meet here for the holding of your convention for the first time south of the Ohio river. I thank you, gentlemen, for your kind attention. (Applause.)

Capt. White's Response.

The President—I will call upon one of our mutual friends to respond to Governor Evans—a gentleman who needs no introduction to you—Captain William Henry White, of New York. (Applause.)

Capt. White—Governor, it is a very grateful duty, in behalf of this Association, to acknowledge the welcome which you phrased so courteously, and to say to you that if you are glad to see this Association south of Mason and Dixon's line, we are glad to be here. We came here with a firm belief in the hospitality of the Southern people. We have tested it in many ways and at many times, and it has never failed us. When we tried to come here some years ago we were not quite so welcome as we are now, still they were as warm in their greeting then as you have been to-day. These hill tops, which have their historic associations for the Southern people to which you have referred, have also historic associations for us who come from the North and from the west. But to-day we have come here on a mission of peace. We have come here to consult among ourselves how we can best "do" the consumers; to find out some means by which the gas meter may be put upon expeditious rollers—we want ball bearings and pneumatic tires for our meters; and it is the sole object of this convention to ascertain the most easy way to accomplish this end. I say this to you the more frankly because I understand that among the many honors which have come to you, you are also a gas man, and can, therefore, sympathize with us in our high ambitions. (Applause.) It is also a very agreeable thing to feel that this body of men, coming as they do from various and scattered parts of the country, can come together in the same place, and there be heartily welcomed in the name of the people, welcomed in the name of the community, and by the men who govern them. For we are, after all, men so closely in touch with the public affairs of the various cities wherein we serve the public that we feel that we too are part of the public machinery of each of those cities. We are certainly a part of the police force, because we furnish the light that enables the policemen to do their duty, and to warn off the rascals who would rob, murder or burn. Therefore, the gas company becomes a part of the police machinery of each town. Our mission to you at this time is one of peace, and I assure you we are delighted to recognize the great and marvellous growth of the City of Chattanooga. We are able to recognize in it that New South which is to us men of the North one of the choicest results of the war. In that New South we recognize the fact that in ending that terrible strife we did not destroy the South; we found a sleeping princess and we simply kissed her, and wakened her to a new life; and the whole South now sees greater beauty in the paths of peace, and greater beauty in the work of the farm than she ever did in the days of slavery. She has learned that there is a dignity in personal labor which she never recognized before. She has come to recognize the fact that a man who with brain and hand seeks to win from the soil his day's wages; who gathers about him as helpers his fellow men, and pays them honestly for an honest day's work, has learned the lesson that money and power are the results only of man's honest endeavor, and that no community grows unless its men are free to labor for themselves. And this New South now grows like a beautiful flower, because she has now learned the lesson of the dignity of human labor. But I want to say for myself, even though I do not voice these other men here about me, who with me did their feeble share during that war, that I do not look with pleasure upon the establishment of this great military park; I am glad that there is but one such in the world, and I would to God that there were none. This little family fight of ours is done. When it was over we shook hands and went our way to our homes—to desolated homes in many cases; to stricken homes in all cases. I would to God that then and there the war had ended; that there were no battle flags with the names of hard-fought fields upon them and no picture such as is upon this hill-top here, recalling to memory the bitterness of that strife. Rather, in God's name, let it end forever and let us be brothers forever. This may not be a popular sentiment, but as I grow older and as these men about me grow older, our hearts soften more, and we look further than to the dreadful days that are ended, and we want

never to bring back to our minds their bitterness. Let us look at the national cemetery as a relic; let the great museum at Washington be the storehouse for forgotten arms, and let those of us who faced each other upon these deadly fields take the bitterness out of our hearts. Let us spread the asphodels of forgiveness over all sad memories, and look forward, one and all, to the great purpose of making this our great country, *the* country of the world. (Applause.)

The President—According to our by-laws, next in order would be the calling of the roll and the reading of the minutes of the last meeting. Unless there is some objection expressed, we will postpone the calling of the roll until tomorrow morning, and dispense entirely with the reading of the minutes—thus following the usual course in that matter in the past. If there is no objection that procedure will be taken. The next thing in order will be the reading of the

PRESIDENT'S ADDRESS.

The President called First Vice-President Odiorne to the chair, and read his inaugural address, which will be found in our issue for last week, p. 811.

The Chairman—You have heard in the President's address not only much information, but a valuable amount of excellent advice. What will be done with it? What is your pleasure?

Mr. Jenkins—I think I voice the sentiment of every man in this meeting in saying that we have listened to one of the most interesting, profitable and valuable President's addresses that has ever been delivered before the Association. In order that the matters treated by that address may be properly brought before us, I move that it be referred to a Committee of three, to be appointed by the Chair. (Carried.)

The Chairman—I will appoint on that Committee Messrs. E. H. Jenkins, Walton Clark and W. M. Eaton.

Report of Board of Directors.

The President—The next business in order would be the reports of Standing and Special Committees, but I believe that we have no Committees of that kind to report. We will next listen to the report of the Board of Directors, which the Secretary will read.

Secretary Dunbar read the report as follows:

The annual meeting of the Board of Directors of the Western Gas Association was held at 9 P.M., Tuesday, May 19, at Lookout Inn, Lookout Mountain, Tenn., and was called to order by the President, Mr. A. W. Littleton. The following members of the Board were present: I. C. Baxter, Detroit, Mich.; Geo. T. Thompson, New York City; Wm. Steinwedell, Quincy, Ills.; Wm. McDonald, Albany, N. Y.; W. M. Eaton, Jackson, Mich.; Geo. H. Harper, Altoona, Pa.; O. O. Thwing, Milwaukee, Wis. On motion of Mr. Odiorne the following papers were accepted for presentation to the Association:

"Municipalities vs. Gas Companies: Their Reciprocal Relations," by General A. Hickenlooper, Cincinnati, O.

"The (Alleged) Law of Inverse Squares," by Mr. B. E. Chollar, St. Louis, Mo.

"A Few Words on Naphthaline," by Mr. John Gimper, Galveston, Texas.

"The Future of the Gas Business in America," by Mr. M. S. Greenough, Cleveland, O.

"Self Education in Gas Engineering," by Mr. Alex. C. Humphreys, New York City.

"Wrinkle Department," edited by Mr. Geo. T. Thompson, New York City.

On motion of Mr. Baxter it was carried that the hours of 10 A.M. and 1:30 P.M. be selected as the time for convening the meeting of the Association.

The Secretary-Treasurer read the following report:

Receipts.

To membership fees	$200.00	
" annual dues	1,020.00	
" sale of badges	31.50	
" balance, cash on hand, May 1st, 1895	331.58	
		$1,583.08

Disbursements.

By Secretary's salary	$400.00	
" sundry bills, as per vouchers	1,005.80	
" balance, cash on hand, May 1, 1896	177.28	
		1,583.08

Membership, May 1, 1895		269
New members admitted 18th annual meeting	20	
Dropped for non-payment of dues	15	
Resigned	4	
	19	
		1
Membership May 1, 1896		270

Badges on hand May 1, 1895	10
Purchased May 2, 1895	30
	40
Sold	9
Badges on hand May 1, 1896	31

The President appointed the following Committees:

Auditing Committee—Geo. H. Harper, O. O. Thwing, and W. H. Odiorne.

On Applications for Membership—Wm. McDonald, Geo. T. Thompson, and W. M. Eaton.

Mr. Thompson moved that, in recognition of his valuable services to the Association, and as an evidence of the high esteem in which he is held, the Board recommend the election of Mr. J. B. Howard to Honorary Membership in the Western Gas Association. The motion was unanimously seconded, and put and carried.

There being no other business, the Board adjourned.

The President—What action will you take in the matter of the report of your Board of Directors?

Mr. Dunbar—I move the adoption of the report. (Carried.)

(Calls for "Uncle Jerry.")

Election of Mr. Howard to Honorary Membership.

The President—We shall all be very much pleased to hear from our friend, "Uncle Jerry" Howard.

Mr. Howard—Mr. President, and Gentlemen of the Western Gas Association: I assure you that this election as honorary member of your Association is to me a very agreeable surprise, and is one of the happiest events of my life. Any words from me would but faintly express the gratification I feel in acknowledgment of the high honor you have done me by thus promoting me to the position of life member. I heartily thank you for your kindness.

The President—I am sure I voice the sentiment of the entire Association in saying that we all thoroughly appreciate the value of the services of Mr. Howard to this Association in the past and in the present, and that there is no way in the world in which we would not compliment him that laid in our power. (Applause.)

Reading the Papers.

The President—Next in order is miscellaneous business. If there is anything of that kind to be brought before us we will consider it now. If not, perhaps we will have time to proceed with the reading of one of the papers. I think we can take up the paper by Mr. John Gimper, and finish that before the noonday recess. Mr. Gimper is not present, and the Secretary will read his paper.

The Secretary then read the paper by Mr. John Gimper, of Galveston, Texas, entitled

A FEW WORDS ON NAPHTHALINE.

At the late meeting of the New England Gas Association, the subject of naphthaline was discussed, and while the subject is an old one it is as interesting as ever, for its problem to the gasmaker has not yet been solved.

The consensus of opinion at that meeting seems to have been that the changes of temperature are the causes of naphthaline troubles, and that if we could reduce the temperature of the gas to a certain degree before it reaches the holders the naphthaline troubles would be avoided.

After an intimate acquaintance with naphthaline, both north and south, I cannot fully share those opinions, and therefore venture to offer a few suggestions. I think my friends have lost sight of one important fact or inducer (if I am permitted the term) of naphthaline appearance, namely, "moisture."

I believe it will be admitted by every gasmaker that we cannot make gas without having moisture in it, and also that a reduction of temperature means a corresponding reduction of moisture in said gas.

When Mr. Sherman[1] used water for condensation of 47° temperature, he condensed moisture, and so much of naphthaline, that he suffered but little trouble from it beyond that point. I believe if Mr. Sherman had been able to take out all the moisture and leave the naphthaline in the gas, he would not have had any more trouble than he had when he removed both.

To prove this statement, let any one try the experiment of depriving gas of all its moisture, not by condensation but by absorption with caustic lime or chloride of calcium, and then subject the gas to the changes of temperature which ordinarily produce deposits of naphthaline, and it will be found that those deposits will not form; hence it is

1. See Proceedings New England Association of Gas Engineers, A. G. L. J., *Ante*, p. 450.

evident that the presence of moisture, and its sudden reduction into liquid form, induce the naphthaline to go with it.

Let us look at this from a chemical standpoint.

The destructive distillation of coal is a chemical process, but the gases formed by it are not chemical compounds, only mechanical mixtures, with no great affinity for each other, and, naphthaline being the only constituent which can crystallize under ordinary conditions, it is easily deposited when the least disturbance takes place in the mixture. And I therefore believe that whenever a deposit of naphthaline has formed, a deposit of moisture has preceded and induced it. It is like two friends going along together, bent on some frolic, one wants to continue in one direction, but the other says "No, let us stop here a little while, and have some fun with the superintendent of the gas company;" but friend moisture is the artful dodger. It gets away into the drips and leaves naphthaline behind to take the blame. I also believe it will be conceded by every gasmaker that we cannot make gas without producing naphthaline, be it coal or water gas. Neither do I believe it will be disputed that high heats produce more naphthaline than low heats. Old gas men tell us that when they were satisfied with 3½ to 4 feet of gas per pound of coal they did not suffer from naphthaline troubles like they do now. The tar distiller tells us that he cannot saturate felt with tar coming from gas works that use regenerative benches, indicating clearly that we have changed the composition of the gas and tar; and having made the assertion that we can not make gas without producing naphthaline, it is natural to ask "Why not?" To answer this question I must ask you to go with me into a little elementary chemistry. Let us first see what coal is composed of; second, what we do with it in the retorts.

Coal is composed of carbon, hydrogen, oxygen, nitrogen, sulphur, iron, lime, silica, alumina and magnesia, with occasional traces of potash, soda, chlorine and iodine.

Upon such a mixture the effect of heat must necessarily vary with the degree of heat, and herein lies the difficulty of the gas maker; in the variations of the heat and the constant changing of the resultant compounds.

At a dull red heat the hydrogen carries off a large quantity of carbon, forming the oily compounds of light hydrocarbons, with a low yield per pound of coal and high candle power; whereas, at a higher heat, the hydrogen, in a great measure, quits the carbon, and, expanding, gives rise to larger yield with corresponding lower candle power.

With these facts before us it would seem that all we had to do is to discover the best point of heat between the two extremes and to constantly maintain that point; but a little reflection will soon convince us that, even though it were possible to maintain this uniform temperature, the material operated upon is not uniform in itself, nor does it remain so during the duration of the charge. Through the first of the charge the quantity of volatile matter is equal to the heat and will be carried off; but from that time on the quantity of volatile matter is greatly diminished. If the heat is not carried off it accumulates and acts with increasing intensity upon the remaining volatile parts, which become overheated and are destroyed; then we make what retort carbon and naphthaline are made.

From the foregoing it would appear that low or moderate heats would indicate the proper method of gas making; but in these times of sharp competition we cannot choose our heats, but we *must* take the 5 foot yield heat, and with it the naphthaline troubles.

I confess I am just as much at a loss to-day to know how to overcome the naphthaline difficulty as when first I gave the subject consideration years ago, at least in so far as it pertains to its troubles within the gas works.

Thanks to the Wrinkle Department of the Pacific Coast Association, furnished by Mr. E. C. Jones last year, I have found, from the works to the consumer, a complete remedy, by admitting gasoline into the main outlet pipe leading from the works to the street main system. I tried it last winter, and can cheerfully recommend it to any Superintendent who is troubled with naphthaline in mains and service pipes. The admission of gasoline simply does to the gas what the light hydrocarbons from the coal would have done had we distilled it at a low temperature. It holds the naphthaline in suspension by reason of its greater affinity to it, than moisture has for naphthaline.

Discussion.

The President—The paper is now before you for discussion. I am very sorry the author of the paper is not present, but in spite of his absence I hope you will give the paper your consideration, and discuss it to some extent at least.

Mr. Clark—I know that Mr. Odiorne, who has something to say about it, is waiting for an invitation.

The President—We shall be glad to have Mr. Odiorne open the discussion.

Mr. Odiorne—I found a very good arrangement for getting over the naphthaline trouble in my works. It is very simple and really costs nothing. When I was using Kanawha coal I found a good deal of naphthaline in the pipes, and had them stopped up frequently. I simply charged my retorts with large charges of native coal, and found that it would free the pipes all the way through and clear out the naphthaline. We charged for half a day in that way, and would not be troubled with it again for weeks.

Mr. Dunbar—Did I understand Mr. Odiorne to say that he used fresh native coal, and that it cleared out the works?

Mr. Odiorne—Yes.

Mr. Dunbar—I never have trouble with naphthaline except when I use fresh native coal. (Laughter.)

Mr. Odiorne—I guess it is not the same quality of coal.

Mr. Dunbar—We use Indiana coal. It is mined in the western part of the State, near the Illinois line.

Mr. Baxter—Perhaps Mr. Odiorne lowered his heat in doing so. Did you lower the heat of the retort, or use the same heat you had before?

Mr. Odiorne—We used the same fire, but probably charged the retorts heavier; it lowered the heats in the retorts.

Mr. Jenkins—The experience of our friends, Dunbar and Odiorne, is a good deal like an experience which I heard about recently. I visited an Ohio gas works (and, by the way, in Ohio they have had lots of trouble from naphthaline), the Manager of which, who is well known to you all, said he found difficulty through the stoppage of the inlet pipes of his holder with naphthaline. That was George Light, of Dayton. He said he got along swimmingly all through the winter—in fact, until the warm wave came through Ohio and Indiana six weeks ago—when suddenly he had trouble from naphthaline at the inlet pipe of the gasholder. He said he studied over the trouble a great deal, and got rid of it by the use of steam, etc.; and that then it flashed on his mind to find out what was the temperature of the inlet pipe of his gasholder. He discovered that the gas was going through the station meter at 75°, whereas it was going through the inlet pipe at about 45° less temperature. In other words, the water at the bottom of the gasholder tank was still at winter temperature—it had not been raised at all; and he found, by making experiments and tests, that there was over 40° difference in temperature within a very few feet distance of pipe. He went on with his experiments of heating certain parts of his works to as high temperature as he dared carry it, as for instance in the purifying room, and had no further trouble from naphthaline. On reversing the operation, and cooling the same portion of the works as rapidly as possible, he got a formation of naphthaline without any trouble at all. At another Ohio works they were having trouble with naphthaline, but without having any trouble between the station meter and the gasholder, and I suggested Mr. Light's experience in Dayton. They made the test and did not find 5° of difference in temperature between the outlet of the station meter and the inlet to the gasholder. So that, while Mr. Light thought he had found out exactly the cause for the deposit of naphthaline, Mr. Cline did not think he had discovered it at all. And that is the way it is with brothers Odiorne and Dunbar. I am inclined to think Mr. Light was on the right track, and that the great difference in temperature between the outlet of the station meter, and before the gas got through into the gasholder, had a great deal to do with the trouble. My own experience has convinced me that wherever gas is cooled suddenly, there is where you get naphthaline; tha if you can carry your gas right through without any sudden change of temperature, and get it into your gasholder without any sudden change there, you will have very little naphthaline. Last winter I tapped the outlet of the station meter for the reason that I wanted to be able to know at any time exactly what kind of gas we were making, and wished to find that out before it had passed into the gasholder. In a pipe which was exposed to the air a good deal we got naphthaline about once in two weeks. I had a 6-inch dip-pipe there, and there the naphthaline was solid; we could cut it out as you could a sperm candle. We got naphthaline at that point, but did not have it anywhere else. That is the experience I have had recently.

Mr. T. D. Miller—I had some experience with naphthaline in the old works at Fort Worth, Tex., more than 10 years ago, and my method of treating it (adopted because of what I had heard) was by steam. I steamed it from the centerseal to the station meter, and steamed it from there to the inlet to the holder. I thought if I steamed it into the holder I did not know what would happen, and so I poured boiling water in at the outlet of the meter and let it run down into the drip at the inlet of the holder; and as fast as one gang poured hot water in at one

place another gang pumped it out at the inlet to the holder. We accumulated in that way, in about 12 hours, a barrel of naphthaline. After that we were troubled very little, or not at all, until the winter season came on again. I believe the hot water treatment is a splendid thing, because it raised the temperature of the pipe and prevented naphthaline getting into the holder. Later on I had a telegram from the Sherman (Tex.) works, where they had heard of my trouble with naphthaline, asking me to come on and advise them. I found them in about the same condition; a 6-inch pipe, about 60 feet long, leading to the holder, was solid with naphthaline. I tried that same way and relief came in five or ten minutes. I have about made up my mind that the best treatment for naphthaline is with hot water. It is not as dangerous as gasoline, and, if not as effective, it is not so expensive.

On motion of Mr. Dunbar a vote of thanks was passed to Mr. Gimper for his paper.

Appointment of Special Committees.

The President—If there are no further remarks upon Mr. Gimper's paper I shall take occasion now, before the adjournment, to announce the appointment of a couple of committees. On the Committee for the Nomination of Officers I appoint: B. E. Chollar, J. B. Howard, T. D. Miller, James Somerville and A. S. Miller. On the Committee to Select the Place of Next Meeting I will appoint: I. C. Copley, James T. Lynn, George T. Thompson, James Ferrier and Jas. W. Murdock. On Final Resolutions: A. C. Humphreys, W. B. Sellers and I. C. Baxter.

The Association then took a recess until 2 P.M.

First Day—Afternoon Session.

Mr. Harper, Chairman of the Auditing Committee, reported that the Committee had examined the books and accounts of the Treasurer and found the same correct. On motion of Capt. White the report was received and placed on file.

Report of Committee on Applications for Membership.

The President—We will now hear from the Committee on Applications for Membership.

Mr. McDonald—Your Committee received the following applications for membership:

Active.

Bates, T. A., La Crosse, Wis.	Lloyd, Jno., Altoona, Pa.
Brown, J. S., Danville, Ky.	Miller, W. A., Cincinnati, O.
Cole, C. H.. Lima, O.	Neely, J. D. S., Lima, O.
Fenwick, A., Henderson, Ky.	O'Malley, P., Aurora, Ills.
Glass, S. J., Milwaukee, Wis.	Russell, J. T., Jr., Selma, Ala.
Hauck, A. L., Cincinnati, O.	Sperry, H. L., Nashville, Tenn.

Stacey, J. F., Nashville, Tenn.

Associate.

Barrows, W. E., Phila., Pa.	Jacobs, C. H., Detroit, Mich.
Clark, G. W., Chicago, Ills.	Kahn, L., Hamilton, O.
Eilbeck, A. B., Phila., Pa.	Owen, W. I., Detroit, Mich.
Eaton, A. B., Chicago, Ills.	Rue, G. W., Chicago, Ills.

Wells, T., Chicago, Ills.

Transfer from Associate to Active.

Callender, E. P., Little Falls, N. Y.

Election of New Members.

Capt. White—I move that the report be received and the candidates named be balloted for; and that the Secretary be instructed to cast one ballot of the Association for the election of the gentlemen named. (Carried.)

The Secretary—In accordance with your instruction I cast the ballot of the Association for the election of the gentlemen whose names have been read.

The President—The gentlemen whose names have been read are duly elected to membership in the Western Gas Association. I hope they will all make themselves thoroughly at home while here, that they will have a pleasant time, and be anxious to come again. The next business in order will be the reading of the paper by Mr. A. C. Humphreys, of New York, entitled,

SELF-EDUCATION IN GAS ENGINEERING.

The subject of education is an all-important one, and especially so in this our day of tremendous activity in the commercial and practical world and of correspondingly eager competition.

In the minds of many there appears to exist the opinion that the progress now so in evidence is destined soon to do away with the occasion for education in the special line of gas engineering. This will be found to be a most misleading opinion.

Great changes will probably occur in our industry in the next ten years; perhaps far greater than during any previous decade since gas was first distributed for purposes of illumination. This points to the necessity for the thorough training of those who are to be responsible for the management of the gas undertakings of the future. It also points to the probability that the successful gas engineers of the future will be almost without an exception men technically trained. But this does not of necessity mean that they must be graduates of technical colleges. If their first training can be obtained by taking a course in mechanical, mining or civil engineering, at Steven's Institute of Technology, the Massachusetts Institute of Technology, the Rensselaer Polytechnic Institute, or at any one of a number of the Universities which now provide special and thorough courses in engineering, it must be a decided advantage; but the man who is obliged to work for his living before he is able to secure such a preliminary training, is by no means debarred from ultimately taking his place in the ranks of the technically trained gas engineers.

A quarter of a century ago, when in a commercial capacity I became connected with the gas business, there were but few college men amongst the American gas engineers. Most of those who were technically educated had obtained this part of their training in connection with the practice of their profession.

To-day a great improvement is to be found. The proportion of technically trained men of both classes has greatly increased. I believe the next ten years will force us to a still greater improvement in this direction.

It is to be remembered, at the outset, that this is not alone a question of training and education, but it is, first of all, a question of character. The man who is determined to fit himself properly for any sphere in life can do so if he has fair ability and an honest, indomitable determination to succeed. It is important that he should, as far as possible, first analyze his mental make-up and then select a vocation adapted to his natural inclination. It would be a mistake to try to make a gas engineer of himself if he is cut out clearly for some other vocation.

My present purpose is to say a few practical words upon the subject of self-education in gas engineering.

I shall, therefore, address myself particularly to those who, while earning their living, are also trying, or should be trying, to fit themselves to take positions of greater responsibility and trust. It is my wish to help those who may have the desire to improve themselves without knowing how to go to work, and also to inspire others to make this extra effort who so far have been contented to plod along satisfied with the performance of their daily tasks. It is apparent, then, that I am to speak to the beginners—those who really are not yet entitled to membership in this Association.

But perhaps I can reach my audience through those here present. If I can induce any of you to place my words before your juniors I shall have not only succeeded in gaining a hearing, but I shall perhaps have incidentally enlisted the co-operation of the seniors, who can, if they will, do so much to assist their juniors.

The relations existing between theory and practice at once come up for consideration in connection with the subject before us.

In a paper which I had the honor of reading before the American Gas Light Association in 1892,[1] entitled, "The Relations Existing between Theory and Practice," I endeavored to show that there should not be any question as to whether a gas engineer should be trained in the practice or the theory of his profession, but that there should be in his training a perfect harmony between theory and practice. I referred at some length to the writings of Rankine on this question.

Amongst other references I quoted this author as follows:

"And the truth began to be duly appreciated, that sound theory in physical science consists simply of facts, and the deductions of common sense from them reduced to a systematic form.

"Another evil, and one of the worst which arises from the separation of theoretical and practical knowledge, is the fact that a large number of persons, possessed of an inventive turn of mind and of considerable skill in manual operation of practical mechanics, are destitute of that knowledge of scientific principles which is requisite to prevent their being misled *by their own ingenuity*. Such men too often spend their money, waste their lives, and it may be lose their reasons, in the vain pursuit of visionary inventions, of which a moderate amount of theoretical knowledge would be sufficient to demonstrate the fallacy; and for want of such knowledge many a man who might have been a useful and happy member of society becomes a being than whom it would be hard to find anything more miserable.

"The number of those unhappy persons, to judge from the patent

1. See Journal, Nov. 7, 1892, p. 650.

lists and from some of the mechanical journals, must be much greater than is generally believed.

"The most absurd of all these delusions, that commonly called the perpetual motion, or, to speak more accurately, the inexhaustible source of power, is, in various forms, the subject of several patents in each year.

"Mechanical knowledge may obviously be distinguished into three kinds—purely scientific knowledge, purely practical knowledge, *and that intermediate knowledge which relates to the applications of scientific principles to practical purposes, and which arises from understanding the harmony of theory and practice.*"

In that paper I said:

"The engineer of to-day, and still more, the engineer of to-morrow, must be trained in the theory and the practice of his profession; that is, he must be acquainted thoroughly with the laws which will govern him in his work, and he must know how to practice in harmony with, and avail himself of those laws. Here would appear to come in the question as to how much of theoretical, or what can be gotten from books, or how much of the practical, or what can be gotten in the shop, should be united to make up the educational equipment of the student-engineer.

"It is hardly within the province of this paper to take up this question, except to claim that there must be such a blending of the two forms of training as to fit the engineer to take up his life's work. In general, however, I believe the engineer does not need to be the finished mechanic; but he should know fully as to the uses of, and the results to be obtained from, all classes of tools employed in his special line (if he is to be a specialist, as he probably will be) and be able to say how a piece of work should be done and how it should not be done."

This question as to the relations between theory and practice is all-important, and it is a question which should be well considered at the very outset of your work as a student. Too often the so-called practical man looks upon the technical man with suspicion. If what I have to say is in any case listened to or read in that spirit, my efforts so far will be useless. It may bring me more into sympathy with this part of my audience if I now say, as I once said in an address to a graduating class of a technical college, that if it were necessary to choose, "I would as a rule select for work to be done the hard headed, practical man, rather than the technical man *who does not appreciate the necessity for the harmony of theory and practice.*" I warned them that they must not think that they would have a walkover in competition with those who could not write "M.E." after their names. But now let me say to the practical man, if I had a chance to choose between the practical man, so-called, and the engineer trained in the theory *and* practice of his profession, I should unhesitatingly choose the latter, and so would employers in general choose.

Much of what I shall now have to say may seem trite, but you may take it for granted that I shall not bring in any suggestions which my experience with employees has not shown the necessity for emphasizing.

My first advice, then, is, recognize fully the necessity for this combination of theory and practice, and let the study of theory lead to practice and let the practice lead to the study of theory. Let each enforce the necessity for the other.

Now let us consider what subjects are to be studied and how they are to be studied.

The studies generally included in a course of mechanical engineering, as defined in our American colleges, are those which I believe to most nearly fit the special requirements of a gas engineer; but as you are to obtain your education under special difficulties we may perhaps specialize still farther and select from this course the subjects which are actually required in following our profession. Having mastered these, it will doubtless be a pleasure to you to go farther afield in the acquisition of knowledge.

I will assume that you have a grammar school education. If you have not, then this must be your first aim. It may seem to you absurd that I should make this point, but let me say that I have more than once found young men without even this foundation to build upon, laboring to master the engineering problems presented in their daily life.

Assuming then that you have a grammar school education, you must next acquire a sound knowledge of algebra, plane and solid geometry and trigonometry, and it will be well if you carefully review arithmetic. Do not be satisfied with *understanding* the problems, but work to acquire facility in the solution of problems. Here at the outset, combine the practice with the theory.

In connection with these studies take up mechanical drawing and the use of the surveyor's level and the transit. If you are so constituted that it is difficult or perhaps impossible to become an expert draughtsman, go as far as you can, and at least acquire such familiarity with your subject that you can "read" a drawing with ease and accuracy.

If you have acquired a sound knowledge of arithmetic, algebra, geometry and trigonometry, you are prepared to go forward. Do not attempt to by-pass these studies as I know many have attempted to do in their course of self-education. To attempt to master the problems of gas engineering without this foundation of sound elementary mathematical knowledge is a lamentable waste of energy and loss of time.

While a knowledge of the *higher* mathematics is not actually necessary in the course we are referring to, the mathematical course specified is a prerequisite.

Now you should take up the study of physics and especially those branches relating to the properties of matter, to mechanics, to heat and to optics. As far as possible make the experiments which are described in your text books. When you reach optics, combine the study of photometry with the practice in the photometer room. Here is a place to be satisfied with nothing short of thoroughness of knowledge and facility of execution. Study the elements of chemistry and try to acquire a good working knowledge of those branches involved in the testing and analyses of gases and in the work of the retort house, the condenser house and the purifier house. Especial attention must be given to certain branches of organic chemistry. It will not be enough to study from your text book; you must do the laboratory work. If your company has a laboratory, you can probably obtain permission to work in it in your spare half hours. If this opportunity is not afforded you, do the next best thing. If you are determined to succeed, much can be done with an inexpensive outfit of your own collecting.

Having acquired in connection with your study of physics a general knowledge of mechanics, you should study applied mechanics to learn how the principles of mechanics are applied in the construction of machinery and the like. Make a special study also of the resistance of materials.

Likewise you should study thermo-dynamics so as to trace the relations between heat and mechanical work. This branch should be covered carefully, at least as to the fundamentals. A good elementary knowledge of thermo-dynamics is now a necessity to the gas engineer, and will become more and more so on account of the progress being made, and the new methods being brought forward, good and bad. Without this knowledge it will in many cases be impossible to distinguish the good from the bad. A knowledge of the elements, even of thermo-dynamics, will, in many cases, enable you to at once point out why the patentee's "sure thing" is of necessity doomed to failure.

But now let us see how we shall pursue these studies. If you attempt to do all this work without guidance, you will find the road a most difficult one. Only a man of sternest resolutions can thus succeed. Therefore, if possible, your course of study should be laid out for you and your work supervised. Not only will your efforts be thus more efficiently applied, but this supervision will give you the spur so necessary with nearly all of us. Even where a general scheme is outlined, and certain definite tasks are set to which you have to conform, the undertaking will still be found to be one that will try the resolution even of those who have the ambition to urge them to the trial.

In some places night schools can be found which will greatly assist you. In some localities there are other institutions which can help you in certain lines. In New York City is the Cooper Union; in Philadelphia, the Franklin Institute; and probably in the West you have similar institutions. I believe in the larger cities the Y. M. C. A. maintain classes in some of the subjects named.

The American Gas Light Association is about to commence a line of assistance work which I hope will be the means of helping many a young man to a higher grade of life's work. This assistance is not confined to those connected with that Association, but anyone connected with an American gas works can avail himself of this scheme. Those who are interested can get particulars from A. B. Slater, Jr., Sec., P.O. Box 1160, Providence, R. I. I urge the young men of the American gas industry to communicate with Mr. Slater, and to avail themselves of this as one of the means to be employed. It is the intention of the Committee in charge to commence the work in a modest way, and to carefully keep in mind the necessity for a simple, practical course.

A great deal of good work can be done by such a correspondence course. There are schools which conduct all their work in this way, and as I happen to know of one which is particularly devoted to technical work, I feel that I am warranted in giving it special mention. I refer to the Correspondence School of Technology, Cleveland, Ohio.

E. P. Roberts, M.E., is President, and he has a full corps of well qualified assistants. The methods pursued are eminently practical, and they show an appreciation of the difficulties met with by those trying to acquire an education by their own efforts. This is not only found in the scheme of education, but also in the opportunities afforded to keep down the expense for text books and the like.

I recommend you to avail yourselves of this source of help rather than to struggle blindly, and perhaps helplessly, by yourselves.

Before making this recommendation I have gone carefully through the question papers, etc., which Mr. Roberts' school employs, and it gives me pleasure that I am able to include in this paper a recommendation so definite and practical as the one I make in this connection.

In Great Britain a custom prevails which might perhaps be imported to this country, wholly or in part, with advantage. Young men are articled to leading gas engineers in active practice for a term of three to five years. The pupil pays the engineer a fee of $1,000 to $1,500. During the period for which he is articled the pupil is given the opportunity to become conversant with the varied routine and detail of gas works management, sharing the experience of, and having his studies directed by, his preceptor. If the pupil is worthy of it, the engineer-preceptor certifies to his qualifications, and thus the way is paved for his first appointment and his future progress. Such a scheme has great merit, where properly carried out on both sides, but it probably fails to meet the requirements of a man who is obliged to win his own way. The student in Great Britain can also avail himself of the opportunities afforded by the City and Guilds of London Institute for the advancement of technical education. Under certain conditions, local classes can be formed for instruction in technology and manual training. The Institute registers the class, inspects its work, and, through appointed examiners, officially conducts the examinations upon the results of which certificates in different grades are awarded; medals and money prizes are given in each subject. The programme of the Institute shows 63 subjects of examinations.

To show the practical character of the work, I mention a few: Salt manufacture, soap manufacture, bread making, brewing, coal tar products, sugar manufacture, gas manufacture, iron and steel manufacture, glass making, photography, dressing of skins, boot and shoe manufacture, spinning (different kinds), dyeing (different kinds), telegraphy and telephony, electric lighting and power, plumbers' work, goldsmiths' work, mechanical engineering, mine surveying, ship carpentry, brickwork and masonry, and the last on the list is dressmaking. It is worthy of note that the course outlined in mechanical engineering is quite different from such a course in a United States technical college. Here mechanical engineering is supposed to cover nearly the same ground covered by the civil engineer's course, except that the former course gives more attention to machinery, shopwork, thermo-dynamical questions, and the like, and the latter course gives more attention to field engineering, foundations and buildings. The mechanical engineering course covers these last subjects; but not so fully. Bridges and roofs are equally covered in both courses. But, if we may judge by the examination papers of the City and Guilds Institute, the mechanical engineering course in England is much more closely specialized. In the ordinary grade the examinations cover questions as to ordinary machine design and drafting, the operating of machine tools, questions in pattern making, questions in fitting, turning and smith's work. The honor grade includes also questions in resistance of materials, applied mechanics, steam, hydraulic machinery and machine design. The course appears to be most thorough, but closely specialized.

In England the title of civil engineer appears to be generic and to apply to any and all engineers not military, and under it are grouped the special classes of mechanical engineer, mining engineer, electrical engineer, etc. This is in accord with the dictionary definition. With us there is no such grouping under the one general head, but the civil engineer is as much a specialist as is the mining, the mechanical and the electrical engineer.

The course of the Institute, in gas manufacture, it may be instructive to note. The programme states that the examinations will include questions founded on such subjects as the following:

Ordinary Grade.

1. The construction of a retort or oven best adapted for the destructive distillation of coal.
2. The setting of retorts and construction of retort furnaces.
3. The effects of temperature in modifying the quantity and quality of the gas produced.
4. The description and arrangement of apparatus employed for the conveyance of the gas immediately upon its leaving the retorts.
5. The description of apparatus best adapted for cooling the gas.
6. The most suitable condition of the gas for effective purification.
7. A description of the various instruments used in gas works for ascertaining and recording pressure and exhaust.
8. The laying of mains and service pipes.
9. The construction of gas meters.
10. The fixing of meters and the fitting up of premises for the supply of gas.
11. A description of the various kinds of gas burners in general use.
12. The use of an exhauster.
13. The methods employed for controlling pressure at the works, so as to secure an adequate supply of gas at the various points of consumption, with a due regard for economical effect.
14. The simplest methods of ascertaining the purity and illuminating power of gas.
15. A description of the materials and methods employed for the purification of gas.
16. Influence of temperature and atmospheric pressure upon the volume of gas.
17. A description of the various tests employed for determining the values of ammoniacal liquor and spent oxide.

Honors Grade.

In the Honors examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of:

1. The characteristic properties of the various kinds of coal, and their value for gas making purposes.
2. The effects of temperature upon the production of residuals.
3. The chemical composition of coal gas.
4. The chemistry of purification.
5. Gas analysis.
6. The development of illuminating power.
7. The practice of photometry.
8. Labor saving appliances in the retort house, and the working of retorts.
9. The construction of gasholders, purifiers and other gas apparatus.
10. The working up of ammoniacal liquor.
11. The principles of combustion, and their application to the working of retort furnaces.
12. Carbureted water gas.
13. The enrichment of coal gas by means of oil, etc.

A provisional certificate only is granted for passing examinations on these subjects. For a full certificate in the Ordinary Grade, the candidate, unless otherwise qualified, must pass the Science and Art Department's examination in the elementary stage; and for the full certificate in the Honors Grade, he must pass in the advanced stage in at least two of the following subjects: Machine construction and drawing, applied mechanics, light and heat, inorganic chemistry, organic chemistry, geology, metallurgy or steam.

The works of reference recommended are: King's Treatise; Newbigging's Handbook; Richards on Gas Works; Dibdin's Photometry; Thorpe's Quantitative Analysis; Thorpe's Dictionary of Applied Chemistry; Cripp's Guide Framing of Gasholders; The *Journal of Gas Lighting*, with special reference to C. Hunt's Lectures on Gas Manufacture, Vol. 51, and the articles on "Coal Gas, its Manufacture, Distribution and Consumption," Vol. 59, 60, 61 and 62; Gas Engineers Laboratory Handbook, by Hornby; Transactions of the Incorporated Gas Institute; Transactions of the Incorporated Institution of Gas Engineers. The course here outlined seems to be most practical.

Having shown briefly how an education can be obtained, even by those engaged in daily work, I want to urge upon the young men so engaged not to be satisfied to drift along, simply doing the work set them, but to each day do something to fit themselves for higher class work; study as you work. Try to understand the whys and the wherefores of the every-day routine. Day by day we are inclined to pass by without comment things we do not really understand, but which we are superficially familiar with because we see them so often. How often is this superficiality demonstrated when the problem presented has even slightly changed its dress. If there is anything which happens around the gas works which strikes you as mysterious, never give up until you have explained the mystery. In doing so you will have mastered many problems besides the special one which you set out to solve.

Let me here include a number of simple, primary test questions suggested by the daily routine. It may be found that even to answer these correctly and definitely some preparation may be required. If so, be convinced that it will pay you to undertake a systematic course of study.

Questions.

How does a chimney operate to "draw" air through a furnace?

Can air be drawn or pulled as you would pull a weight by means of an attached cord?

If there is an opening in the chimney somewhere between the furnace and the top, why does it interfere with the draft?

How does a pump operate to "pull" water from a well?

Can water be sucked or pulled up from a lower level as you would pull up a bucket with a rope?

How does a syphon lift water?

An exhauster placed at the gas works is used to send gas therefrom to an outlying holder, and in doing so it pushes the gas; does an exhauster, as ordinarily placed, "pull" the gas from the retorts?

Why must we cool gas to eliminate the condensable vapors?

Why do we remove sulphur compounds from gas?

Do we remove ammonia for the same reason?

Is there an additional reason?

As a purifying agent, is lime more efficient as ordinarily used, or is it more efficient when mixed with water and used as an emulsion?

If latter form is more efficient, why was its use abandoned in favor of the drier form?

In making water gas, we split up the water into hydrogen and oxygen, the latter going to the carbon to make CO; to so split up the water a certain amount of energy is required. What relation does this quantity bear to the quantity of energy obtained by the recombination of H and O, to make same quantity of water originally decomposed?

If by the tables we learn that through a given length of pipe of given size a given quantity of gas can be delivered in a given time with 1 inch of pressure, and the initial pressure is 1½ inch, what will be the pressure at the end of the pipe?

In delivering water, the pressure is found to be greater at the bottom than at the top of a hill—why is the reverse true in the case of gas?

If a high building is equipped with ordinary burners of uniform size, why does a single pressure regulator, placed in the cellar, fail to give uniform results on the different floors?

Through an opening the size of a pin we can maintain with water or gas any obtainable pressure upon an air-tight vessel of sufficient strength to withstand the pressure. If another opening of the same size as that used for supplying the pressure is made in the shell of the vessel, what must be the relative speeds of the ingoing and outgoing fluid to still maintain the same pressure?

A given quantity of gas is burned through an ordinary gas burner and the same through a Bunsen or atmospheric burner. In each case complete combustion is obtained. In each case the flames are allowed to impinge upon a piece of iron. Why is the iron raised to a higher temperature in the case of the Bunsen than in the case of the regular burner?

Would there be any difference in the actual quantity of heat given off by the gas due to the difference in the methods of combustion?

A certain quantity of water is delivered through a pipe of given diameter and length. If we reduce the diameter of the pipe, length remaining the same, what change must we make in the pressure if the quantity delivered is to remain the same?

Point out the analogy between this case and the burner case just referred to.

If your boiler, in consuming 100 lbs. of coal, gives you the full useful effect of 70 lbs. (in this case your boiler has an "efficiency" of 70 per cent.), is it within the range of possibility to design a boiler which will do the same amount of work and effect a saving of 50 per cent. of the coal consumed?

Why does a beam sustain a greater weight when placed on edge than when placed on the flat?

As you get along in your studies, try to apply what you learn to your daily work. Let the theory and the practice move hand in hand. Let the one teach the necessity for the other. Not only will this push you forward more rapidly, but it will make your course far more interesting.

In the best of the technical colleges this is the course now pursued. You will have in your daily routine the opportunities for the practice if you avail yourselves of them. As I am talking to those who are now in the practical line, it should not be necessary to say much in this direction; but I know by actual experience as an employer that the necessity exists. Is it not a fact that many of the so-called practical gas men, and especially those who sneer at the man technically educated, are not truly practical men, but simply have by daily contact grown familiar with the outside of practical things and are incapable of doing well the very things the knowledge of which serves as their claim to position as practical engineers?

Do not be satisfied with any such superficial knowledge, be it practical or technical. Learn to perfectly perform all the mechanical work in connection with a gas plant, in the works and on the street. In a regular technical course I should advise the student not to attempt to acquire sufficient facility in all branches of shop work as would enable him to compete with the mechanics in the several branches; but in such a course as we are now speaking of, as you are probably more or less involved in mechanical duties, I urge you to strive for facility of operation as well as a thorough understanding of the work, and especially in the more important matters learn to do the work as well as it can be done.

It may be hard for you to get the opportunity to work up all branches, but if you show a determination to make yourself proficient, your superintendents will probably give you the opportunity.

But remember that, first of all, must be perfectly performed the duties for which you receive your wages. I know of no more aggravating employee than he who neglects his daily work, but points with pride to the excellent work he is doing outside of his regular duties. I had such a man once on my hands, and I trust I may never have another.

This leads me to another point. There is one feature in your education (for it is, in part at least, a matter of education) which must not be lost sight of, and should not be, no matter what was to be your vocation in life. Be conscientious in your studies and in your practice. Do your work thoroughly. The boy who sweeps out the superintendent's office thoroughly is more worthy of respect than the superintendent who conducts the business of his employers in a half-hearted and indifferent manner.

A man may be practically educated or theoretically educated, or his education may be a harmonious combination of both, but if he is not conscientious and thorough in his work then his education is not of real value either to himself or to his employer. Those who are blessed with a predisposition to thoroughness are already in great measure prepared to take their places in the van.

Before closing let me remind you that to be a gas manager you must be more than a gas engineer. There is in addition required a knowledge of the laws of trade and the ability to handle your employees so as to get the most out of them with the least effort to them and to yourselves. Fairness is a good ally in both of these cases. As a rule the people you meet in trade and your employees will treat you fairly if you set them the example.

Another most important item is a knowledge of double entry bookkeeping. Not only should you be able to obtain good results, but you should be able to clearly and correctly record those results for the information of your employers and for your own guidance and admonition. Perhaps there is nothing else which so helps to the obtaining of good results as the analyzing of the results already obtained. I have always maintained that the engineer with his mathematical education should be able to acquire a knowledge of accounts as readily as anyone. A man who makes a practice of analyzing his construction cost is seldom an extravagant builder.

I have been particularly struck with the combination of this technical and commercial knowledge so often found in the British gas engineer. It is a very practical combination and one worthy of our emulation.

In closing, let me again urge the juniors in our gas companies not to rest satisfied with a superficial knowledge of their business. Let them strive to learn the principles involved in their daily round. Then may they be prepared to take a higher place in the industry, or at least to better do such work as is intrusted to them.

And finally, let me urge the superintendents and managers here present to be ready to hold out as opportunity offers a helping hand to those under them who may be trying to make up their minds to the undertaking. Sometimes a very little encouragement so given may be of incalculable value to those to whom it is extended. Perhaps you can, without failing in your duty to your company, gratuitously assist a worthy and ambitious employee, by granting him, in a measure at least, such assistance and guidance as does the British engineer in the case of his articled pupil.

Or better yet, if your company is an important one and able to undertake such a scheme, you may be able to induce your directors to organize and bear the burden of a general scheme for helping any and all employees who may be willing to devote some of their spare hours to the work of self-education. Such a scheme is worthy of your sympathy and your help.

Discussion.

The President—I think we must all admit that Mr. Humphreys' paper is a most able and excellent one. It is now before you for discussion. Will some gentleman start the ball a-rolling.

Mr. Chollar—I would like to express the opinion that if any young man in the gas business, no matter what his position may be, would keep this paper constantly before him and read it every day, follow out its advice, study all the questions presented, and not fail to understand any one of them—taking one at a time, and not fail to thoroughly master every point—he would in a very few years become a master engineer. It is a model for every young man to study, not only on the lines presented but on similar lines. The profession of engineer is at present a most equivocal one, if not the most equivocal one in the world as a profession. The lawyer is acknowledged by the courts; he is made a lawyer at a school, and is admitted by the courts as a lawyer, and permitted by law to practice his profession. The doctor is educated at a school, and is permitted by law to kill his friends and enemies at pleasure—and no law can touch him, provided he does it according to the books. But the engineer enjoys no such favorable position. An engineer, no matter what his education may be in a school, will not be an engineer on leaving school; he must become a practical engineer by reason of his own after efforts. An engineer must be self-educated. After he leaves school he must be self-educated; and the way to educate himself is to master each point that comes up, one at a time, and follow up the instructions given, if he would succeed in his profession.

Mr. Dunbar—Any superintendent who has enough technical education can, by following the course mentioned in this paper, become an engineer, provided he is energetic, persevering, and has an average amount of ability, can he not?

Mr. Humphreys—I think so.

Mr. T. D. Miller—I regret very much that Mr. Humphreys did not write this paper 12 or 13 years ago, for it would have helped me out of many a hole. I am not through with the paper by any means, for I shall give it closer study after I get home. I am very glad to have heard it, and am very glad indeed that Mr. Humphreys has written it.

Mr. McDonald—It seems rather hard to say very much about this paper, because we all so thoroughly agree with what the author said, but if word of mine could be of use, or could help any one to a better knowledge of his business, I would be very glad to speak it. I am satisfied Mr. Humphreys looks at this thing in much the same light that I do, although I have never become a practical engineer. The point I wish to make is this—following out a few words that he said, and which I have tried in my life to follow, and which have been of great value to me. First, I have tried to be thorough in what I have done. I believe that is one of the great things for every young man, middle-aged man, or even older man, to practice. Try to be thorough, letting nothing go by that is possible for one to understand if by any effort he can come to an understanding of it, Next, in all his efforts let him be honest—I mean with himself. Of course we are all expected to be honest with those who are around us, and I think that the man who is thoroughly honest with himself is bound to succeed in whatever he undertakes, let that be in whatever business you please, whether as engineer, in the mercantile business, or in the professions of which Mr. Chollar spoke, of doctor or lawyer. If he is honest with himself and with those around him, and honest in his efforts, he will certainly succeed sometime in getting somewhere near to the top of the ladder.

Mr. Clark—As a young man I shared with every uneducated man in an almost superstitious admiration for a technical college education. I believe that now I do not undervalue a technical college education, but I do not regard it, as I did then, as the one thing necessary to succeed, even in the gas business; but of that, a little more later. I do not think it necessary, and indeed I think it rather harmful, to confuse the ideas of a boy, who is trying to get an education, with the harmonies or the differences between theory and practice. The theories that he will find stated in standard works have been already settled by men who are better equipped than he is, or than he probably ever will be, to test their accuracy. If he will take as proved what he finds written in the works which are recognized as standards in engineering matters, and will devote his energies to obtaining a knowledge of principles and an accummulation of facts, he will do very well, although he may have no idea as to the harmony of theory and practice. I am very glad that Mr. Humphreys emphasizes the importance of a knowledge of accounts. I consider such knowledge highly important to success. Possibly a man may build a bridge, or even a gas works, which will be all right in operation, without a knowledge of double-entry book-keeping; but he will never get the satisfaction out of life without such knowledge that he will have with it. As I look at it, those who are trying to make a success in the gas business may be roughly divided into three classes. First, the class of men with indomitable wills, of whom Mr. Humphreys speaks—the young fellows who come of educated families, have educated surroundings, and have the determination to get an education. We need not worry about them; they will get it. Such a paper as this by Mr. Humphreys will be of great help to them. The next class is composed of young men, who, with educated surroundings, have added the determination of somebody (their superior in position) that they shall learn the business. Such was my fortunate position. Those young men we need worry very little about, and to them again Mr. Humphreys' paper will be of great aid. But there is a third class, a class about whom we can worry a great deal. It is the class whom we can do the most for, and who are most in need of our help; it is the class of young men who are working for eight or ten hours per day, who have nobody specially interested in them to push them forward in their positions, nobody specially interested in their getting an education, and who possibly, and often, are surrounded by circumstances tending rather against than for an education. It is in aid of such, as I understand it, that the "Practical Class" of the American Gas Light Association was particularly formed. I would not say to those men, "When you get through with your work, go home and put in your nights in study;" for I do not think that the greatest success will come to those men by spending four or five hours every night on their books. To a certain amount of study they must devote themselves if they wish advancement; but it is not and should not be expected of them that they will be able to devote all their time to work or study, and yet make rounded and completed men of themselves—and to be a rounded and completed man is a great deal better than to be only a technically educated man. I am afraid men of that class will take some discouragement from Mr. Humphreys' paper. Understanding it thoroughly, possibly they will not; but they very likely will. Men of that class, unless gifted with indomitable will and with the spirit of self-sacrifice, cannot go through the course which has been laid down in Mr. Humphrey's paper, and at the same time do what else is necessary to make them rounded men, and make them men most fitted, after working among men, to get the most out of life. The young man who is compelled to work during the four years that another man is in college should comfort himself with the knowledge that he is getting that which the college man is missing. It is probably admitted by most of those who have given the matter their candid attention that there is no four years' training that fits a man less to be useful *immediately* than the four years that are spent in a technical college. The man who has a purely technical education is not, immediately after his graduation, the most desirable man to deal with. He has the foundation for becoming a most useful member of the engineering class, but his college has not given him all that he needs; and something of that which is needed by him has been gotten by the man who has not been in college, but who has been putting in his years in working among and rubbing against other men. It is not everybody who can get the biggest prizes in his chosen profession; it is not everybody in a gas works who can follow out the course laid down by Mr. Humphreys in this paper. But everybody can do something towards it, and I hope no man will be discouraged by the apparent magnitude of the task here set before him. I hope that all the young fellows will take hold of it who can, but they should do so recognizing and appreciating the fact that success in life does not always mean occupying the highest positions—whether in the engineering profession, in the legal profession, or among the doctors or ministers. Success in life is something away beyond that; and that success may be attained by any man working in any capacity—in a gas works or anywhere else—and whether he is able to obtain a technical school education or not. (Applause.)

Mr. Chollar—I have no doubt Mr. Humphreys has outlined in his paper a very desirable course of study, and one which can be followed with advantage and profit by anyone who desires to advance in the profession of gas engineering. I think, however, he has not emphasized the study of geometry sufficiently. I would emphasize it more. I venture to say that if a young man would spend one hour per day for the length of time required to go through a technical school, and at the same time be continually in practice at a gas works, he would come out at the end of that time practically as good a technical engineer as if he had gone through a technical school.

Mr. Howard—After hearing Mr. Humphreys' paper I cannot help comparing the advantages within the reach of so many young men at the present day with those which were obtainable years ago by those engaged in the gas business. When I first commenced in the gas business 40 or 45 years ago, young men who wanted to get information in

the gas line had to be friends or relatives, or in some way connected with an engineer, in order to obtain any information at all. Then all the gas works in the country were locked up—you could not get inside their gates; and if you wanted to get any information you would be told, as I was once told when I asked a trifling question regarding the working of the center-seal, "You cannot be told that; that is a matter secret to the profession." Then no papers were read; no paper was devoted to the gas interest; nor were there any books published which would enable a man to study and learn the secrets of gas engineering. How different it is to-day. I do not wonder at the many young men now coming to the front, with the opportunities that they have of gaining knowledge in their chosen profession from books, and from the sources of technical information and the knowledge of practical duties which are open to them, as compared with the condition of affairs 40 or 50 years ago. I am glad to see the progress that is being made, and if this progress and advance continue for the next 40 or 45 years I do not know what may not be accomplished by that time.

Capt. White—I should dislike very much to have this excellent and interesting paper pass without personally thanking Mr. Humphreys for his suggestions. I think it has been the experience of all of us who have spent a number of years in this line of work that one of the most difficult questions which we have to answer is that of the young men who are desirous to study our business, as to how they can best acquire the knowledge. It looks to us to be not in accord with the times to have to say to such a man that he must do to-day as we did years ago, that he must go into a gas works and commence at the bottom, and learn by hard knocks, no matter what his previous education may have been, the story of this line of work. Mr. Humphreys has very clearly set forth what I may term an ideal method by which any conscientious worker in a gas works, or any young man in your office, who has an ambition to be something more than a clerk, or any young man in the general office of a company who recognizes an opportunity in our line of work, and appeals to you for information, can obtain it. The course is possibly a little too technical, and possibly a little too extended; but, with our experience, we can indicate to such a young man clearly his line of study. It was my experience upon coming from school and endeavoring to take up this line of study to find, just as Mr. Howard has said (for I am rather an old fellow in the business in spite of the fact that I am still one of the "boys"), that a knowledge of the business was hermetically sealed up in the gas works; that an outsider could learn nothing, could acquire no information; and that no man would more instantly resent any intrusion into his works than the engineer. If perchance the President's son desired to acquire the knowledge pertaining to the making of gas, instead of welcoming him, as we do now in our works, they feared his becoming a competitor for their places later on, and they simply would not have him there, and gave him no information. To-day any young man is gladly made welcome to such information as we have. The establishment of these societies a quarter of a century ago broke down the Chinese walls around our gas works, and made the knowledge which gas men then possessed free to those who have grown up since. Without entering into any discussion of the question of the relative importance of practical and theoretical knowledge, I may say it is exceedingly important that the young men of to-day should know how they can best and most readily acquire the knowledge of this business which will make them useful men. Therefore, any indication or any signboard which will point out the road for these young men to follow in the line of study is of great benefit to them and to us. Personally, I esteem this as one of the most valuable papers read for a long time in my hearing in the meetings of this Association. It is valuable to this extent—it recognizes the fact that our forces to-day must be recruited from the young men who are coming here, and that they should have some indication of the line of study they ought to pursue. It is true that those of us who wasted (from Mr. Clark's position) four years in college study, learned after all to understand and to appreciate sound, correct and honest knowledge; and if we did not know so much of our fellow men as did the boy who grew up, from the first, battling for life with his fellow men, still we learned a great deal that is useful, and on a much surer foundation than did that boy. Therefore, whatever technical knowledge we can start with from schools and universities, so much the better. But graduates of college, after all, on coming into your gas works must have some line of study which will be of use to them, and such a line of study is clearly indicated in this paper. The busy gas engineer has not a great deal of time to give to the young men about him. He desires conscientiously to help them, and it is important to him to know how he can best do so. Most of us recall the fact that a few years ago there was nothing but the elder Clegg's book, and a few other half forgotten books, upon the subject of gas making, that there were no technical books on the subject of gas engineering, and that there was really nothing to which we could direct the attention of a young man desiring to study, except to our own works, and tell him to follow those works from day to day, and when an accident occurred to do as this paper has indicated, find a reason for that accident, and in finding that reason obtain much information in other directions. It is not necessary that in this line of study your employee should spend four or five hours a night; but with a certain line of study fixed, or if in connection with his practical daily work he has some book which he can read, or some line of study which he can pursue in his leisure hours, even if he can devote to it but one hour of the 24, that man is enriching his knowledge, is widening his intelligence and making himself more thoroughly useful in every direction. Certainly no man here, no matter how practical he may be, will deny that a technical knowledge of the business which he has chosen as his life work is of great value to him. He cannot know too much; and any honest and conscientious worker will seek to acquire that knowledge. This paper simply takes the rubbish out of his path and indicates what is best for him to know; how much of it he has time to acquire is a question to be determined by himself. I think the Association owes Mr. Humphreys a debt of gratitude, and I feel that I personally owe him that debt; for the question is asked, not once a month but once a week, in my office, by men who are desirons of placing their sons in gas works, how to put them there, and what they shall study.

Mr. Humphreys—I am glad that the paper has excited any discussion at all; I was afraid there would not be any. I note particularly Mr. Clark's criticisms; and I was very anxious to hear them because I wanted to check myself up, and to check myself up carefully by the views of a man who has, as I know, taken a great deal of interest in this educational subject. While he approached it very much from the same direction as myself, there was still a very great difference in the views expressed. Mr. Clark, as he intimated, entered a gas works with a fair education, came of educated people, and was practically forced into his education; or at least he put it in that way. But I do not believe it, for he is of a studious disposition, and, so far as I know him, I do not believe there was much forcing done; but Mr. Forstall did no doubt assist to push him forward against the knowledge which he should acquire. Now, Mr. Clark has gotten his education in that way, or stated it in that way; but I think perhaps he does himself an injustice in thinking without that push and drive from the outside he would not have gone forward. I certainly do not agree with him in thinking that there are but few who could have gone forward without that. In a conversation that I had with Mr. Clark on this subject recently, he placed me in the first class. But I think there are plenty of young fellows who have just as much of an "indomitable will" as I have; and I believe that the trouble does not come so much from their not having a will to go forward as in their inability to find out how to go, for very often the will is there, if they could only receive the first encouragement. To be personal for a moment, I may say I believe the course I have outlined here can be carried out exactly as outlined. Or, to put it a little differently, I believe that it can be carried out as fully as I have outlined it, quite as well as I was able to do what I did. Although, as Mr. Clark remarked the other day, I had unusual opportunities, from the fact that I had friends who were directors of my first company, who permitted me to take a technical course at the same time that I cared for my business; still it is to be remembered that I undertook a great deal more than I have here outlined. It may not have done me so much good as if I had confined myself to a narrower course; but nevertheless the work was done, and I believe that there are dozens and dozens of our young men who can go through with the course I have outlined as well as I was able to complete that fuller course. Therefore I speak from my own experience. With regard to the question of theory and practice I may say I think, as Mr. Clark does, that we do not want at the outset to confuse the mind of a young man by abstruse discussions. Unfortunately, however, that question is likely to come before him at the very outset, for the minute he talks about becoming an engineer, or pursuing anything in the line of a technical course, people will at once take up the argument with him as to whether he should learn it in the shops or in the schools. Therefore, at the very outset, I tell him that I do not believe he should learn in either alone, but that he should learn it in both. I would not advise any young man to work 8 or 10 hours a day for his daily bread, and then study 4 or 5 hours *every* night at home, and think of nothing else but his work by day and his study at night. This is not necessary. There is no reason why he should not be able to do his work and still have a little time for play. But we know that everyone who is going to succeed to-day has to put in some hard knocks at the start. There is no use sitting down and saying that this thing is easy

to accomplish, for it is not. I would be sorry if any word of mine tended to discourage anybody from going forward; but if I discourage one and encourage two then I am glad of what I have said. I believe, with Mr. Chollar (although I cannot go quite as far as he does), that if a boy will put in even one hour a day in study he will, at the end of four years, be able to show a very marked progress; but I emphatically do not believe that he would be as well grounded and as well capable of going forward in his work as one who had received a more liberal technical education.

Mr. Chollar—For practical purposes, I said.

Mr. Humphreys—Even for practical purposes I do not believe that he would be. I believe that extremely practical questions would come up that he would not be able to grapple with as well as the man who had given four years of undivided attention to study and practice, and who had afterward had opportunity to carry forward that practice. I cannot agree with Mr. Clark in thinking that there is a narrowing influence in a college education. On the contrary, I think that the study required at college broadens a man. Let us take our own experience of men who have come to us right from college; we find them wonderfully qualified (there may be exceptional men) to take up general or even commercial questions. It is necessary in writing a paper of this kind to outline in a few words, or in a few pages, the work to be performed during many years, and many obstacles must be apparent; and if such a paper is read by a man without resolution, it may discourage him. But he must bear in mind, as Mr. Chollar points out, that he does not have to take all those doses at one time. The obstacles are shown, or some of them at least are suggested in such a paper, but he must bear in mind that he does not have to meet them all at the same time. They are encountered one at a time, and they can be overcome as they are encountered. You know how it is in going down a country road on an incline, with another incline looming in front of you; we see the whole elevation at once. It looks from near the bottom of the first incline like a wall standing in front of you. When you come to it you are often inclined to think that there is no elevation at all. So the young man here has all his troubles presented to him at once; but he will meet them one at a time. I have the greatest respect for practical men and for the practical side of technical education—the greatest possible respect—in spite of the opinions of some. I commenced at that end of it myself; and I never started for the other end until I found how impossible it was to go forward as I wanted to without a technical education. But at the same time I think we deceive ourselves if we do not bear in mind that the practical man can help himself wonderfully by preparing the way; and very often that preparation is suggested by the very difficulties he meets with in practical life. Then he goes to work and prepares to remove some of the obstacles which he otherwise must meet, and, having done that, he is able to do not only the thing he started out to do, but he is able to take up the whole task. I think there is barely a chance of a man who is earning his living as a mechanic, as a workman, or as a clerk, and who is really ambitious to improve himself—I think there is barely a chance of that man narrowing himself by study. The practical, everyday life he lives will prevent the books from narrowing him; and the books will prevent his other work from narrowing him. I do not think there is any chance of danger in that direction. I do not think we need worry over that part of it, for practically the broadening out will come later. We cannot do all together. Let him get his education from his books and the workshop. He will be very well prepared to broaden out later on.

Mr. Clark—There seems to be a serious misunderstanding about my expressions, which I desire to correct. I did not say, or at least I did not intend to say, what Captain White has credited me with saying—that the four years spent at college were wasted. I intended to say something very different from that. I did not intend to say what Mr. Humphreys has credited me with saying—that college education was narrowing. I did intend to say, I think that the purely technical education, such as is given at some of the technical schools of this country is narrowing. I have the greatest respect for college education—as I will evidence in my family if I live, and have the means. I may have said (perhaps awkwardly) that a technical education sometimes makes a man a disagreeable person to associate with; but if I said that, I was wrong, and did not quite express my meaning. I meant to say that the boys who come from purely technical schools, or from schools in which the technique only is taught, do not come to us fitted to do the work that they could do if they had something else besides that technical education. In other words, to be able to do the work which a technical education is supposed to teach a man to do, he must know something more than is taught in technical schools. The whole idea of my criticism has been the encouragement of the boys who will probably read this discussion. They can do a great deal for themselves, although because of their surroundings, and of the work they are compelled to do, they may not have the opportunity of following out the course laid down by Mr. Humphreys; but, as I have said before, as I understand it, the work of the "Practical Class" of the American Gas Light Association, is intended to reach and to help just that class.

Mr. Chollar—This discussion reminds me of something that happened to me in the army of the Potomac in 1862. I had just graduated from a college a few months before. It was not a technical school, but it was somewhat similar to West Point in its mathematical and physical courses—a West Point graduate was President of the college. Shortly after graduating I joined an engineering regiment in the army. The captain of my company was a very technically educated man—extremely so, and he had done some considerable engineering work in the army before the War. In 1862 our regiment went into camp on precisely the grounds where the Washington (D. C.) Company's new gas works are built. The company that I belonged to were unfortunate enough to have their street right through a gully, and the tents were built on each side of that street, facing each other. The different companies had their tents back to back. Our street was no street at all, but simply a great big gully, 15 feet deep at one end, and hardly anything at the other. As we were an engineering regiment, we had all sorts of prismatic compasses and surveying instruments, and, in fact, all the instruments that could be desired. The captain came to me and said: "Now, Chollar, you are an engineer, and I want you to have that gully filled up. I wish you would get the instruments out and cross section this gully, make an estimate of what is required to fill it, and then we will have it filled up." Said I, "That is all right, captain; I have got that done already." He said: "No; you cannot have done that, for you have not been out here at work at all." "Yes, I have," said I, "and I know exactly what will be required. I have got the estimate ready now." Said he, "How much will it take?" Said I, "Captain, it will take the full of it." Then we went to work with our wheelbarrows and filled it up. (Laughter.)

On motion of Capt. White, the thanks of the Association were tendered to Mr. Humphreys for his valuable paper. (Carried.)

The President—We will now pass on to the consideration of the next paper, by Mr. B. E. Chollar, of St. Louis, Mo., on

THE (ALLEGED) LAW OF INVERSE SQUARES.

The night wind with desolate moan swept by; and the old shutters swung screaming on their hinges; and the moon, as the torn edges of the clouds flew past, struggled aslant the stained and broken panes so dimly, that the watchful eye of death scarcely was conscious when it went and came.

The fire beneath the crucible was low; yet still it burned; and ever as his thoughts grew unsupportable, he raised himself upon his wasted arm and stirred the coals with difficult energy; and when the rod fell from his nerveless fingers, and his eye felt faint within its socket, he shrunk back upon his pallet, and with unclosed lips muttered a curse on death.

The silent room from its dim corners gave back his rattling breath; and the humming in the fire had the distinctness of a knell and when duly the ancient horologe beat one, he drew a phial from beneath his head, and drank. And instantly his lips compressed, and with a shudder in his skeleton frame, he rose with supernatural strength, and communed with himself:—

I did not think to die till I had finished what I had to do. I thought to pierce the eternal secret through with this, my mortal eye. And yet 'tis death, and in my eyes the death sparks flash and fade.

According to title and also to the general understanding of readers of the poem, the poet was picturing the death anguish of a discouraged alchemist; but the allusions within the space of a few lines to the moon, the watchful eye of death, the fire beneath the crucible, his eye feeling faint, piercing the secret with his mortal eye, and the flashing and fading of the death-sparks, all of which references being more or less suggestive of the subject of light, would almost make one think that the poet had gotten his title mixed with something else, and that the old man might not have been an alchemist at all, but perhaps the original promoter of the rule of inverse squares.

Whether, it were he or somebody else makes but little difference at present.

The law laid down in the books, as orthodox doctrine, is taught

in such a way as to convey the inference and impression that, as a general proposition, the intensity of light decreases in proportion to the square of the distance from its source ; and that the law is based upon and is due to some inherent property of light itself ; whereas, as a matter of fact, light has nothing whatever to do with the law and the alleged rule is simply a law of geometry—of space.

Any force, or representation of a force, radiating from a point, must necessarily advance in diverging lines. There can be no parallel lines, for parallel lines, cannot pass through a common point ; there can be no converging line,s for a point has no area.

The lines of force from a point being radial, the same intensity will be found at equal distances from the point, that is to say, at the surfaces of concentric spheres.

Surfaces of spheres, cubes, octahedrons and similar polyhedrons are to each other as the squares of their diameters. The intensity of a force radiating from a point will decrease therefore in proportion to the square of the distance.

Let us now consider conditions under which a force may radiate not only in diverging, but also in parallel and converging lines.

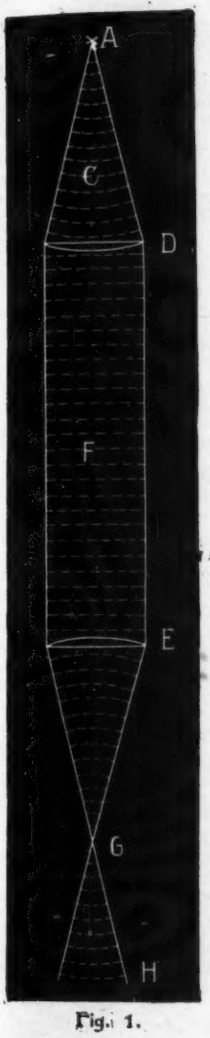


Fig. 1.

Let the point A in Fig. 1 represent a radiating force. Since the intensity of radiation will be equal in all directions, we may without error consider only such part of it as comes within the limits of the cone C, shown in section.

From A to D the intensity of the force will decrease with the square of the distance, independent of the angle C. The lines of force will be divergent, or, what is the same thing, the wave fronts will be convex, and the intensity at D will depend for its value upon the distance AD.

If at D we interpose a device that, without absorbing any of the energy of A, will change the directions of all the lines of force so as to make them parallel, and consequently the wave fronts plane surfaces, the intensity at E will be the same as at D and independent of the distance DE. Hence parallel lines of force neither increase nor decrease in intensity, but maintain a constant value for an indefinite distance.

At E let us again interpose a diverting device as before, but one which will converge the lines of force to a focus at G. The wave fronts from E to G will be concave, because all the energy at E will be concentrated at a point, at G.

The conditions between E and G will then be exactly the reverse of those existing between A and D. From A to D the lines of force are purely diverging, and the intensity will decrease according to the law of squares. From E to G the force lines or rays, if we choose so to call them, are purely converging, and the intensity of radiation must necessarily increase according to the square of the distance, the limit of which distance, however, is G, where the lines cross each other in a point.

We started at A with a point of radiant force—a luminous point we may call it —and have passed with its force to D, thence to E, at an indefinite distance, and have arrived at G with another luminous point of an intensity the same as that with which we began. It follows therefore, that the light from a luminous point may be reproduced at an indefinite distance with an intensity equal to but not exceeding that of the source.

We have seen from the foregoing that a pencil of rays diverging from a point decreases, and that a pencil of converging rays increases in intensity according to the rule of squares, and that a beam of parallel rays holds its own indefinitely, neither increasing nor decreasing.

We have seen also, that in case of a force radiating from or to a point, the angle of divergence or convergence cuts no figure so far as the alleged law is concerned.

Let us now consider rays from a surface and purely divergent.

At E, in Fig. 1, let us interpose two other devices one after another, both being represented by JAK in Fig. 2, one of which, instead of converging the parallel beam to the point G will diverge it to the surface of the circle DE, and the other to that of the concentric circle BC, larger than DE.

The source at JAK will be the same in both cases; the distance AX will be the same in both cases; but the intensities at the distance AX will be inversely as the squares of the diameters BC and DE, and not according to the square of the distance.

Let us now suppose the area of source JAK without change of energy gradually to diminish until it becomes a point at A: then the points B and D, and E and C will coincide with F and G, and the angle JXK will coincide with the line AXY, that is to say, will become zero, and the light from the point A will decrease as the square of the distance.

It is plain, therefore, that light originating at a point and radiated from a surface will decrease or increase in intensity according to the angle of divergence or convergence.

In actual every day life, and outside of laboratories, optical instruments and the fixed stars, we find no light having the characteristics of the kinds mentioned above, but we do find them mixed together in all conceivable proportions, and it is upon these relations that the commercial value of artificial lights in a considerable degree depends.

The books agree to a remarkable extent in regard to lack of a specified and precise definition of what is meant by the term "diffused light." A search through the libraries would probably

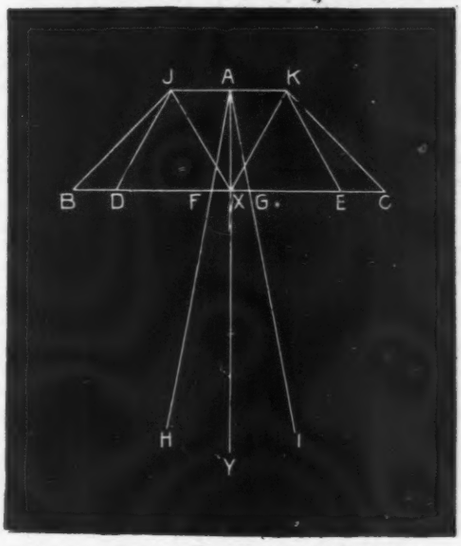


Fig. 2.

result in failure to find anything satisfactory. Some individuals, however, define it as light reflected from a roughened surface; others say it is scattered light, while still others think that "soft light" expresses the idea pretty well. One at least has been known to define it: "well, when I say diffused light you know what I mean, and when you say diffused light I know what you mean." One "practical" man said "a diffused light is one that diffuses and that is all there is about it."

It is easy to distinguish between a light that is diffusive and one that is not; but to define the term "diffused light" so as to give an exact idea of the same, is quite another thing. The term soft light is an antonym for sharp light. A soft light comes from a large surface, while a sharp light comes from a small one. A sharp light casts a clear cut, well defined shadow, while a soft one makes a shadow with the edges more or less blurred and indistinct.

The light from a point is the sharpest possible. The light from the clouds is the softest possible. The light of the former consists totally of diverging rays, while that from the latter contains a minimum of rays of that kind. Diffused light, therefore, is light composed of converging, parallel, and diverging rays; light without

any definite wave front; light that cannot be brought to a focus; light that does not come under the law of inverse squares. The larger the area of the source, and the greater the proportion of converging and parallel rays, the greater will be the diffusibility of the light.

If light from a surface were emitted in truly radial directions only, that is to say, if all the lines of direction were to pass through a common point located somewhere behind the surface, the doctrine of inverse squares would be correct and satisfactory; but such is not the case.

Take the light and heat from the sun for example:

The diameter of that body is 800,000 miles, while that of the earth is 8,000. The sun's diameter is an hundred times greater than that of the earth, and its surface ten thousand times greater. The sun radiates its light and heat not alone into the infinity of space, but every square foot of our little earth receives the converging energy from ten thousand square feet of the sun's surface. In addition to this, every foot of the surface of the earth receives the radiated energy in a parallel beam from an equal surface of the sun, and every point of half the sun's surface sends a pencil to the surface of half the earth.

If the rule of squares were true, the light and heat of the sun would be far beyond the utmost limits of any possible human comprehension: on the contrary however, if a reasonable view of the case be taken, the sun's temperature and light can come well within the limits of mortal conception.

An artificial light will be diffusive in proportion to its converging and parallel rays, that is to say, in proportion to its size. The more it diffuses, the more it diverges from the rule of inverse squares.

Gas lights are the largest and most diffusive of artificial lights, and within the limits of several feet in distance do not come under the rule. An ordinary gas flame at a distance of twenty feet subtends an angle as great as that of the sun from the earth.

The graduation of the photometer bar is based on the hypothesis, that the law of squares being orthodox must therefore be correct.

Gas lights, by reason of their large size, are better than the photometer indicates; the photometer discriminates against them and in a measure tends to the disparagement of gas property.

An instrument that informs us that a common white globe intercepts two-thirds of the value of a gas light, when common sense tells us that it does not, is not to be trusted in a business so large as the gas industry.

The members of the gas fraternity ought to uphold and advocate to the fullest extent the merits and excellencis of their product, and under no conditions surrender the slightest advantage to any detraction from the value of their goods. There is no monopoly of scientific knowledge, and a fair working quantity of it can be accumulated with but little cost and no excessive amount of work. Both cost and labor will be more than compensated for by the satisfaction that will be derived therefrom.

That every member may be able to think, study, and judge, each for himself, and avoid being led into error by the perverting pedantry of pedagogy, is a consummation devoutly to be wished.

Let us hope, therefore, that the paper on the subject of "Self Education in Gas Engineering" may be followed by others of the same kind, and that the training class of the American Association may also be continued until all the members of our associations become not only *ex-officio*, but also *de-facto* gas engineers, with sufficient self-confidence not to believe everything they read in the books.

Discussion.

The President—We are now ready for the discussion on Mr. Chollar's paper, and we shall be glad to hear from any member who takes exception to any of Mr. Chollar's statements.

Mr. Humphreys—I have read Mr. Chollar's paper in advance and with interest. It may seem to some, who have not followed closely the recent Association discussions of this and allied topics, that this paper does not need detailed reply. But it seems to me there is danger in leaving it unanswered. Owing its authorship to a man as well and favorably known as Mr. Chollar it cannot be lightly passed by.

When I presented my paper on photometry to the American Association last fall, it would have been well if Mr. Chollar had been afforded the opportunity to have made a studied reply. I requested the President well in advance of the meeting to appoint Mr. Chollar to lead in the discussion, but it was thought that he had already been assigned to as much of this work as in fairness a single member could be asked to undertake. Had Mr. Chollar been so appointed, he would have received one of the six advance copies of my paper, but in the absence of such a reminder I forgot to supply him. Had Mr. Chollar been afforded the opportunity to discuss the subject at that time to his complete satisfaction, it is possible we might then have gone farther in clearing up the disputed points. But in view of the grave importance to the gas industry of the matter involved, it is after all, perhaps, better that Mr. Chollar should have the opportunity to present his case in his own way, unhampered by the necessity for replying to the arguments of others. We can assume that Mr. Chollar is now presenting his case in the strongest possible light, and that nothing has been left unsaid which is important in support thereof. Danger is to be apprehended from a paper of this kind, written by a man so well known as a successful gas engineer:

1st. Those not well grounded, or those considering the question hurriedly, are liable to be led astray, and instead of ascribing to their proper causes the apparent failures of agreement between illuminating power and illuminating effect, are apt to have their faith in a fundamental scientific truth shaken. A man so affected is not in a position to properly direct in connection with the lighting problems presented.

2d. The practical student-engineer is tempted to believe that there is no fundamental principle, no matter how completely it may have been demonstrated and how long accepted by the greatest minds of the past and the present, that can be by him safely accepted. This must be fatal to his progress.

3d. The public (and especially as represented by the reporter of the daily paper) obtains a warrant for saying that the instrument upon which we depend for determining the illuminating value of our product is based upon a false principle, and that the chief engineer of one of our largest companies is their authority.

I say, therefore, that we are warranted in replying to this paper in detail, and I hope that replies will be called forth from men much better able to handle the subject than am I.

Mr. Chollar says, "The lines of force from a point being radial, the same intensity will be found at equal distances from the point; that is to say, at the surfaces of concentric spheres." I presume Mr. Chollar here intends to acknowledge the truth of the law of inverse squares in the case of a point as the source, and I therefore presume he meant to say that in the case of concentric spheres the same effect would be found at every point on the surface of any one of a number of concentric spheres.

Mr. Chollar here and in other places appears to accept the law as it applies to force (energy) emanating from a point, and where no controlling influence is brought in to divert the energy along other lines.

I quote from the paper again: "Let us now consider conditions under which a force may *radiate* not only in diverging but also in parallel and converging lines." How can a force (energy) *radiate* in parallel or converging lines? There is a contradiction in the very language selected by the author.

The word radiate means "to emit or send out in rays from a point or surface; cause to diverge as from a center; as the sun *radiates* light." The author then goes on to show how the "lines of force" will be changed in direction by interposing a diverting device for that purpose. The fact that the direction can be changed by a "diverting device" does not in any way serve as a demonstration that the energy, if not so controlled or specially directed, will not radiate in accordance with the law of inverse squares. The fact that a pencil of light is controlled by a system of lenses, and is sent forth in a parallel or approximately parallel beam of light, does not serve in the slightest degree to prove that the light before it passed through the lenses was not radiating in accordance with the law of inverse squares.

In connection with figure 2, in his paper, Mr. Chollar shows how the direction of the lines of force can be modified in other ways. No one disputes that such modifications can be effected if the required lens or its equivalent is interposed. But again I say, this does not in the slightest affect the question as to the natural lines of radiation.

Mr. Chollar, though, goes farther and says that in actual everyday life we find light in diverging, converging and parallel rays. He states that if light from a surface were emitted in truly radial directions only, the doctrine of inverse squares would be correct and satisfactory, but that such is not the case. He also takes up the case of the heat radiated from the sun towards the earth, and attempts to show that the light and heat from the sun, if radiated to the earth in accordance with the law of inverse squares, would exceed in intensity anything that could be taken in by the human comprehension.

There Mr. Chollar has taken up the wrong case. If the rays from the sun (so much greater in diameter than the earth) did not diverge or radiate from each point of its surface, but converged in accordance with the Chollar theory, we should all be made unpleasantly warm.

It may be well to here remind Mr. Chollar that all the astronomers guide themselves by the law of the inverse squares, and without such a basis for their calculations, they would be absolutely at a loss.

The fact is, there is no converging of rays, as Mr. Chollar seems to propose, but each point of the earth's surface receives the sum of effects due to each point of the exposed surface of the sun radiating its heat towards the earth in accordance with the law of inverse squares. The rays from *each point* of the sun's surface must necessarily diverge.

Now, where does Mr. Chollar's fallacy creep in?

It seems to me that, first of all, he allows himself to fall into error by losing sight of the way in which light is propagated. He, in one or two places, speaks of light waves, but generally his arguments seem to be based upon the idea that light proceeds from the radiating points in the form of a bunch of rays or lines of light. It is convenient to speak of a light ray, and it is convenient to show its direction by a straight line. But we must at once come back to the wave theory of light propagation if we are to discuss any question with precision. Such a line denotes only the *direction* in which light passes. If light really consisted of a bunch of rays emitted by a source of light, think what would be the result as we got farther and farther from the source. At first these rays might be so thoroughly compacted that their intersections might occupy the whole area of an intercepting sphere. But as we intercepted the rays with a sphere larger and larger we must sooner or later come to a case where the inside of the sphere would not be so covered with light, but would only be lighted up at regular intervals with dots of light, and in between these light-ray intersections there would be spaces of darkness. And these dark spaces would increase in size as the sphere increased in size, and, finally, we would have a sphere lighted up by a uniform distribution of luminous dots upon a dark surface. The larger the sphere the less number of luminous dots would there be to a unit of surface, and this decrease in number would be in accordance with the law of inverse squares. While this might be one way of conveying a mathematical conception of the law, it is absolutely foreign to the truth as to the method of propagation, as a moment's thought will convince.

Light radiates from a point as a wave or as a constantly expanding sphere. That is, the light effect is probably produced by the rapid lateral vibration of the ether, and this vibratory action is propagated as a constantly expanding sphere. As the sphere expands so does the light move forward to the spaces beyond. The speed of transmission is measured by the rate at which this sphere expands. In the case of an instantaneous flash, we have as it were a single sphere constantly growing in size and with almost indescribable velocity (the radius of the sphere increases in length 187,000 miles a second, which is about the velocity of light) and illuminating objects in its path momentarily as it flashes by in its expanding course. A constant source of light gives a succession of such expanding spheres, succeeding each other so closely as to give an effect of constant illumination to all objects in the path of these expanding spheres. No matter how the light effect may be caused, it is easily demonstrated that the effect is propagated as a constantly enlarging sphere. It is inconceivable that the effect can be produced by a great number of *lines* of light diverging from a common center.

Now, if we consider the light emanating from a point, and imagine a straight line from that point in any direction, this line will be the axis of a *cone of light* propagated in the way shown. Now, this cone of light will go on expanding indefinitely (as it of necessity must, being part of the expanding sphere) unless we interpose something to divert it from its normal course or to change its course of propagation. For instance, we can interpose a lens which will receive the diverging rays and send them forth again as parallel rays, as we are in the habit of loosely speaking, or to be more exact, it will take a pencil of light, which is being propagated as a cone, and so change the process that the light will be propagated as a cylinder. As a cone, constantly advancing and increasing, its base will be constantly increasing, and, therefore, the light effect first coming from the point or apex will be spread over the base of the cone, and must decrease in intensity inversely as the square of the distance from the apex. After passing through the lens, it is propagated as a cylinder; that is, the space illuminated will be a circle of constant area and hence the intensity will remain constant.

No natural form of energy is propagated in parallel lines unless as the result of the interposition of some such modifying device as in the case of light and lens as referred to. And this Mr. Chollar practically acknowledges to be so in the case of energy emanating from a point.

If, now, we have a source of energy which has area or volume, the only reason why the several points which go to make up the surface should not act as if they were isolated would be because there was some conflicting inter-action between these points; that is, that the proximity of other point-sources of energy prevents any one point from acting as it otherwise would in accordance with the law. But is there any good evidence of such a modification of the radiant action? Quite to the contrary. To take up an extreme case.

The rays of the sun can be concentrated by a lens or burning glass so as to melt iron, or even platinum. If the point where this tremendously concentrated effect is obtained is located, and if through the location so found we look at right angles to the course of the sun's rays upon, say a piece of printed paper, we are able to read the print the same as if these feeble rays were not passing through the highly concentrated rays from the sun. In many other ways can it be demonstrated that light rays are propagated through the normal atmosphere without interference from other and intersecting light waves. There is, then, no reason why, if the law holds good for a single point, it should not hold good for a number of points assembled together as a surface.

Now, let us see about Mr. Chollar's parallel and converging rays from a surface or line. Let the source of light be the line ABC, and let us select any three points, A, B and C, and around them draw the circles A′A″, B′B″ and C′C″, respectively, to denote the expanding spheres of light vibrations. If we draw the radii AA′, BB′, CC′ parallel to each other, we have AA′ indicating *one* direction in which light is radiated from the point A, BB′ indicating *one* direction in which light is radiated from B, CC′ indicating *one* direction in which light is radiated from C, and these lines indicating direction happen to be drawn so as to be parallel to each other. The same can be said of the lines AA″, BB″, CC″. But these lines of light do not act together to produce a parallel beam of light. They have no effect upon each other—no connection with each other. It simply happens that two or more light-sources, points, in radiating light in accordance with the law of inverse squares, produce similar and equal effects at A′, B′ and C′ respectively, and it also happens that if we draw lines from these points respectively to A, B and C the lines so drawn are parallel. Also the light points A, B, C produce at A″, B″ and C″, respectively, similar and equal effects. These in the same way are parallel because they are selected lines of direction of light propagated in connection with the spheres A′A″, B′B″ and C′C″, respectively. These lines proceeding from *three* point-sources of light are in no way the equivalent of the cylindrical pencil of light obtained by the action of a lens upon a conical pencil of light proceeding from a *single* point.

In the same way it can be shown that there is no converging of rays from the points A, B and C. We can draw lines of direction

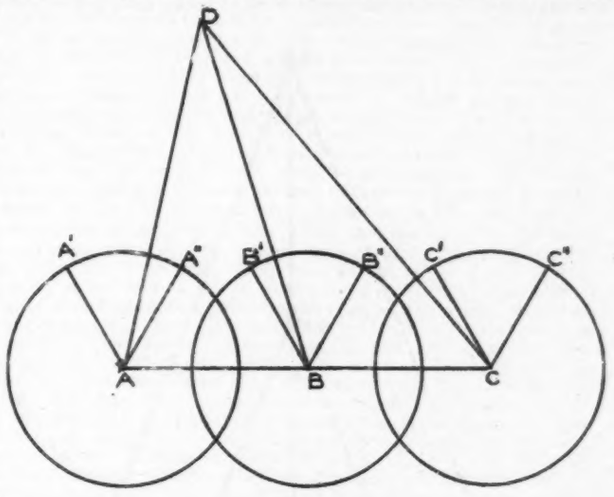


FIG. 1.

from A, B and C, respectively, and these lines can be drawn so as to converge at one point as D; but this simply indicates that the light-spheres expanding from the centres A, B and C respectively, in accordance with the laws of inverse squares, meet at the point D, and hence at D we get the combined lighting effect of the sources A, B and C, and the relative intensities given by the three points at D will be inversely as the squares of DA, DB and DC, respectively.

In "actual every day life" we do not find the mixture of converging, diverging and parallel rays, but we find light propagated as in expanding spheres, each point of light having its own expanding sphere, and this holds good of the light scattered or diffused by irregular reflection. Take for instance the case of radical change effected by enclosing an arc light in an opal globe. Much of the light is no longer propagated direct from the arc to the retina. The translucent globe now becomes a light source and from every point of the globe the light is being propagated in obedience to the law of inverse squares, modified to an extent in the direction of the globe by the obstruction presented by the globe's surface.

As before shown, the direction in which light is propagated from certain points of the globe will be parallel to the lines of propagation from certain other points, but they are independent of each other; they proceed from independent point-light-sources; they are not in any way the several elements of one pencil of parallel rays; and they do not interfere with each other.

An experimental method invented by Tyndall in connection with his studies in "Heat" serves to demonstrate the law of inverse squares in the case of a radiant *surface*, although at first thought it seems to disprove the law.

He placed a thermo-electric pile, S, in front of a rectangular vessel filled with hot water and having its face coated with lampblack. The pile is placed in the small end of a hollow cone, having its inner surface blackened to prevent reflection. Upon trial it is found that the distance of the pile from the vessel may be changed, but the quantity of heat received will be the same. If S′ is taken as twice the distance of S from the box, the surface of the circle A′B′, whole rays fall upon the pile at S′ will have twice the radius and and four times the area of the circle AB, whose rays fall upon the pile when at S. But while the available radiating surface, as far as the inside of the cone is concerned, is four times as great, the intensity due to each element of the increased surface will only be one-fourth as great, owing to the divergence in accordance with the natural law, and, therefore, the net result is the same. The in-

creased available radiating area is compensated for by the proportional decrease in the heat obtainable from each element.

It is to be noted that Mr. Chollar agrees that the laws governing the distribution of any form of radiant energy must depend upon the laws of geometry, but he claims that "the orthodox doctrine is taught in such a way as to convey the inference and impression that, as a general proposition, the intensity of light decreases in proportion to the square of the distance from its source, and that the law is based upon and is due to some inherent property of light itself; whereas, as a matter of fact, light has nothing whatever to do with the law, and the alleged rule is simply a law of geometry—of space." The first part of this statement is correct: the law is laid down, and correctly so, as a general proposition, to be followed, except in abnormal cases, and where there are present abnormal modifying conditions. But as to the law being so taught as to convey the impression that it is based upon some inherent quality of light, I think Mr. Chollar is in error. I certainly can say I have never come across a text book where there was anything to convey that impression to my mind.

We have seen how the law will operate in the absence of extraneous influences. Is it singular that when we come to make a comparison between two sources of radiant energy that we should find it necessary to eliminate as far as possible all modifying and limiting conditions? Even in our coarser work are we not accustomed to eliminate disturbing elements so as to bring the cases for comparison down to a common level? If we attempted to measure the speed of a river steamboat, we should not expect to drive it against the current and then say its speed was measured by the distance passed as measured on the river bank. To correctly gauge the speed of the steamer we must allow for the retarding effect of the adverse current. In measuring the volume of a gas we take account of the influence of temperature and pressure if we expect to make any exact comparisons.

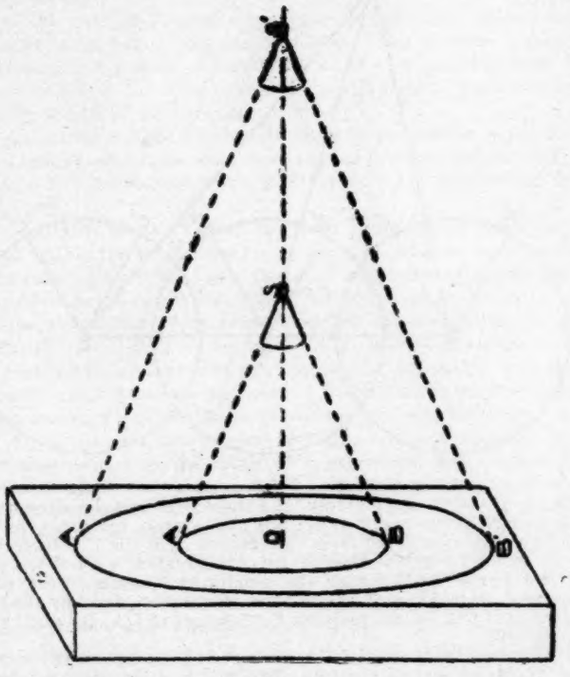


FIG. 2.

So in photometry, we eliminate as far as possible all disturbing conditions, and upon our care in this direction the accuracy of our work depends. For instance, we take the light from the two sources to be compared direct upon the screen. Reflected and diffused light are not allowed to reach the screen, and this is done so as not to get multiplication of effect from the same source. In every way we provide, or should provide, for comparing the light as first given off by the light sources to be compared. This is as fair to one source as to the other. As far as the rule of inverse squares is concerned, the two light sources can so be fairly compared. It is true that the color composition of the lights, the size of the light sources; the way in which the light source is shaded or otherwise modified; the primary intensity of the light source and the consequent effect upon the human retina; the way in which the light source is concentrated or sub divided, etc., etc., all have their due effect upon the final illuminating affect as appreciated by the human eye; but these are questions outside of the one now under discussion, and it is only through a failure to understand the underlying principles involved that the modified effects obtained by one or more of these influences are held by some to form an impeachment of the truth of the law of inverse squares. In my paper of last year previously referred to, I have carefully considered these effects as practically experienced, and I believe I have there shown that every one of the apparent contradictions can be reasonably explained away.

But there is one modifying condition yet to be considered, and this cannot be entirely eliminated. As Mr. Chollar truly says, the law is based upon the assumption that the light-source is a point. We have seen, though, that where the source has area (as is practically always the case) the area is made up of a number of point-light-sources, and from each of these the light radiates in accordance with the law and without interference. Hence, the effect produced by a light-source of area made up of many points, is the sum of effects obtained from each of the points. If we could successively isolate each point of a light-source of uniform intensity, and measure the effect upon a screen at a fixed distance, the intensity of illumination upon the screen would be exactly the same in the case of each point, *except for the difference due to the differences in distance from the several points to the screen.* For instance, if the light-source was in the form of a portion of the surface of a sphere, with the center of the screen as the center of the sphere, then this difference would be eliminated.

Now let us see how serious a matter this difference is in a practical case. If in practice it is found to be negligible, let us not waste time splitting hairs over the proposition that theory and practice do not exactly conform, but let us devote our time and energy to the minimizing of *all* sources of error. This is a step in the direction of the harmonizing of theory and practice.

In my paper before referred to, page 220 of the Transactions, October, 1895, I give a table wherein I compare the intensities of illumination found on a photometer disc in the cases of 60-inch and 100-inch bars, and for 1 candle, 2 candles and 10 candles standards, and 16, 20, 25, and 30 candle-power gases. I show the distance in each case between the standard and the disc. Let us take the 60-inch bar, as the one most generally used and preferably so in case of ordinary gas testing. We will take the case of 2-candles standard as one ordinarily employed. Then we will take the case for 16 candle-power gas, for here the distance of the screen from the standard is the greatest, and hence the distance between the screen and the source to be tested is the shortest. In this case the difference referred to will be a maximum. The first distance is 15.66 inches, and hence the latter distance is 44.34 inches. Assume that the light-source to be tested is a flat flame, and that the flame can be circumscribed by a circle 4 inches in diameter. Then the luminous points farthest from the center will be those farthest from the screen, and their distance from the center of the flame will be 2 inches. The distance of these points from the screen will be $\sqrt{44.34^2+2^2}$. And the intensity of illumination on the screen from the center point, will be to the intensity of illumination on the screen from any point at the edge of flame, as ($44.34^2+2^2=$) 1970 is to ($44.34^2=$) 1966, or as 1 to .998. This is a difference of one-fifth of 1 per cent. But this is the difference between the center and the edge. To find the actual correction we must find the average distance between *every* point in the flame to the point in the screen where it is intersected by the normal through the center of the flame, or what is the same, the average length of the elements of a right circular cone whose altitude is 44.34 inches, and whose base is 4 inches in diameter. Finding this average distance and squaring it we find it to be 1968.6 inches. Therefore, the intensity of illumination of the screen from the center light-source-point, will be to the average intensity of illumination from all points of the light-source, as 1968.6 is to 1966, or as 1 is to .9987.

In the case of a 16 candle power light this would make a difference of (16–15.979) 21 thousandths of a candle.

We may, therefore, fairly claim that this element of difference is negligible. Therefore, while in the case of the ordinary, everyday light sources, the size of the source does have a material influence in softening the shadow effects, by reason of the lights from some parts of the source illuminating the spaces in shadow to other parts of the surface, the effect as tending to disturb our photometrical measurements is not appreciable or to be easily measured.

Mr. Chollar seems to be exercised as to the definition of the term "diffused light." He says a search through the libraries would result in failure to find "anything satisfactory." Would it not have been fairer if he had said that such a search had proved unsatisfactory to him? If the dictionaries and the text books are consulted there will not be found any material disagreement, and hence I fail to see what occasion Mr. Chollar has for his doubts. Diffused light is the result of diffused reflection. The term, "diffused reflection", is used to distinguish from specular reflection, which last is the reflection which takes place from a mirror, and which obeys the law of equality between the angles of incidence and reflection. Light reflected from a piece of white paper, for instance, is scattered in all directions. That is, each point or element of the surface becomes a light source. The fact that certain people choose to use the word "diffusion" in ascribing to different kinds of light a comparative difference in the distance penetrating power of these lights, which difference in penetrating power has in reality no existence, should not bar the rest of us from using this word with its proper meaning. I note the two attempted definitions: "Well, when I say diffused light, you know what I mean; and when you say diffused light, I know what you mean;" and, "A diffused light is one that diffuses; and that is all there is about it." I note, also, that a "practical" man offers the last definition. I think we are warranted in looking for a higher development of common sense in the truly practical man. Evidently the men

using these words as a definition did *not* know what diffusion meant, but were simply familiar with its effects.

I note that Mr. Chollar prefers to use common sense in measuring the light intercepting effect of a white globe instead of using a measuring instrument. Let me ask him if he follows the same course in his engineering work. I remember lately examining with great pleasure a device recently invented by him for demonstrating graphically the vagaries of an imperfect consumer's meter. The instrument performs its office most perfectly. As far as I could see, every pulsation of the meter bellows is recorded. Any eccentricity of the valve motion is shown in the pencilled curve. Why go to this trouble? Why not look at the meter, give his common sense full swing, and write down without further assistance a true diagnosis of the meter's ailments?

I presume it is this same kind of common sense which enables the "kicking" consumer to keep track of his gas consumption without mental effort, so that at the end of the month he is able to say that he knows our record of his consumption is wrong, that he knows he is right, and that the accuracy of the meter is not to be considered in comparison with the accuracy of his common sense determinations. I am a great believer in common sense, but I deprecate such misuse of the English language.

I note with pleasure that Mr. Chollar approves of the movement now being started to assist our younger men to obtain an education in gas engineering. My own experience though somewhat bitter, leads me to say with him that there is no monopoly of scientific knowledge. But I do not agree with him that a sufficient quantity of knowledge can be obtained without extra labor. A little knowledge can be easily obtained, but a little knowledge is sometimes a dangerous thing.

I am glad to be also able to agree with Mr. Chollar in encouraging our younger men in their educational work, to cultivate self-confidence. I know that in my course at Stevens I accepted no demonstration until I had worked it out for myself, because chiefly I felt that unless I did so I should not really master the principles involved. If the problem was simply an example, and the answer I obtained differed from that in the text book, my modesty forbade me to at once believe that I was right and the author was wrong. If I finally failed to get an agreement I took the matter up with some third party as arbitrator.

But if this disagreement was found in the case of the fundamental principles of science, a principle endorsed by the master minds, and a principle which had been verified and re-verified in numberless ways, I felt that I could assume that the law was correctly stated, and if I could not follow the demonstration it was an indication that I was not up to my work and that it behooved me to buckle down still harder. With Mr. Chollar I advise our students not to slavishly accept what is presented in the text books, but I will go further and advise them not to be in a hurry, because they meet some point which they cannot at first understand, to assume that Newton, Tyndall, Herschel, Draper, Morton, and a long list of other intellectual giants living in an atmosphere of science and being continually engaged in scientific investigations, were willing to accept as the truth what they, the beginners, were quickly able to see as error.

Independence of mind is a good thing, and we are gratified to find it in our juniors. Hasty and presumptuous criticism is generally worse than useless.

The President—Is there any other gentleman who would like to speak upon the subject of Mr. Chollar's paper?

Mr. A. S. Miller—I think Mr. Humphreys has covered most of the points of this paper, and I do not know that anything I can say would do more than emphasize the points he has made. I at first read this paper somewhat hurriedly; and knowing the fact that Mr. Chollar appreciates a joke perhaps better than any other member of this Association and finding that every demonstration that he makes in the paper is to the effect that the law of inverse squares is true, I thought it was intended for a joke, and that he intended to sit there and laugh at our trying to persuade him that the law of inverse squares was true when he had already demonstrated it very clearly in his paper. In the first place he admits it when he says that all forces going from a point must necessarily travel in diverging lines. This is the same as saying that they vary inversely as the squares of the distances. Further on, and about the middle of the third page, Mr. Chollar says, "Hence parallel lines of force neither increase nor decrease in intensity, but maintain a constant value for an indefinite distance." I do not think that is demonstrated at all in the paper; or that the fact that the force is the same at E and at D is proof of that statement. In other words, that such is the case is the effect and not the cause. I think also that a wrong term is used on the top of page 4, or rather beginning at the bottom of page 3, where he says, "From E to G the force lines, or rays if we choose so to call them, are purely converging, and the intensity of radiation must necessarily increase according to the square of the distance." I do not think that this is a case of radiation; it is simply a case of controlled lines of force. He says, at the bottom of page 4: "We have seen from the foregoing that a pencil of rays diverging from a point decreases in intensity according to the rule of squares, and that a beam of parallel rays holds its own indefinitely, neither increasing nor decreasing. I do not think Mr. Chollar has demonstrated that at all; he simply makes the statement that such is a fact. There is no demonstration. Further on (page 5), Mr. Chollar refers to JAK as a source. From every point of a "source" light goes in all directions in diverging lines. Therefore JAK cannot be a "source;" it is simply some refracting medium controlling certain lines of force. In certain directions from JAK no light would go at all; and, therefore, it is an error to speak of JAK as a "source." Then he says that "The intensities at the distance AX will be inversely as the squares of the diameters BC and DE, and not according to the square of the distance." I again take issue with him on that point, because on BC and DE the light falls apparently from points which would be determined in the one case by BJ and CK continued back to the point of intersection, and in the other case from DJ and EK continued back to the point of intersection; and the light would vary inversely as the square of the distances from those points. Again let us suppose, as Mr. Chollar says, that JAK shrinks to a point. In such case either one of two things would happen. If it were strictly a mathematical point, as we may assume it is to be, the light would not be broken up. It would either go through without refraction, if it were the center of a lens, or it would be refracted according to the index of refraction of the refracting material. As he assumed two different materials, the refraction would vary according to those materials, and EC and BD would not coincide as claimed. Then he says: "In actual, every day life, and outside of laboratories, optical instrustruments, and the fixed stars, we find no light having the characteristics of the kinds mentioned above, but we do find them mixed together in all conceivable proportions, and it is upon these relations that the commercial value of artificial lights in a considerable degree depends." This whole discussion, as I understand it, centers around the practical value of the photometer which is in the laboratory; and Mr. Humphreys, I think, has made pretty clear the error of the photometer. Taking a very much more extreme case than he has, which would be a 60 inch bar, a 4 inch flame to be tested, and a standard whose candle power is equal to that of the flame, we would then have the screen in the center of the bar, or 30 inches from the test burner. That being the case, the distance from the center of the screen to any point on the edge of the test burner, or 2 inches from the center of the burner, would be the $\sqrt{30^2+2^2}$ or $\sqrt{904}$; and the ratio of the light received at the center of the screen from a point at the center of the burner, to that received from a point at the edge of the burner, would be as 30^2 (which is 900), is to 904, or .9956. In other words, the light received from a point on the edge of the flame would be .44 of one per cent. less than that received from a similar point in the center of the flame. This would be the worst point. The candles would tend to counteract this error, and so the average would be much less than this. So, assuming the worst case straight through, the error is so small as to be well within the errors of observation. As Mr. Humphreys has pointed out, diffused light is light coming from an infinite number of light sources, each pencil of which does have a definite wave surface. Mr. Chollar objects to the law of inverse squares, because the intensity of the light and heat at the sun would be so great, if we were to assume that law to be correct. By the law of inverse squares, if we hold an opaque screen between the eye and the sun at such a distance that we can only see a portion of the sun as coming through a hole in the screen, and then advance towards the sun continually, then the amount of light received by the eye would always be constant; which is but another way of stating the experiment which Mr. Humphreys showed. On the other hand, figuring the heat, Sir John Herschel made some experiments in South Africa, when the sun was in the zenith; he absorbed the heat in water, and, after a long series of experiments, came to the conclusion that sufficient heat was received from the sun to melt an inch of ice on the surface of the earth in 143 minutes. Figuring this back by the law of inverse squares there would be emitted from each square foot of surface of the sun 445,000 heat units per minute, which would be equivalent to a consumption of 1900 pounds of coal per square foot of surface per hour; which is only about 60 times as much as is burned per square foot of grate of the ordinary steam boiler working under forced draft, and which is well within human comprehension. As regards the intensity of the light of the sun, when figured by the law of inverse squares it comes to not over four times as great as the positive carbon of an arc lamp, which I also claim is within ordinary human comprehension.

The President—If there are no further remarks on this paper perhaps Mr. Chollar would like to talk back to some of these critics.

Mr. Chollar—All I have to say in reply is to tell you a little story. Right after the war I went up to Central New York to live, and there got acquainted with an old gentleman named Dr. C——, a very good doctor and very nice gentleman. He had a patient, semi-occasionally, named Mrs. Maloney. She sent for him one time, and the doctor went there. She said, "Doctor, I am sick, and I want some medicine." The doctor, who knew her pretty well, gave her a fine, big dose of physic, and said, "Mrs. Maloney, I will come again to-morrow and see you." The next day he went over there and says he, "Mrs. Maloney did your physic operate?" "Oh, yes, doctor; it operated." Said he, "Well, did it operate a good, long while?" "Yes," said she, "it operated a good, long while." "Then you think it did you some good, don't you?" "Well, doctor, although it operated a good, long while, I don't think it did me much good, because it was mostly wind." (Laughter).

Capt. White—If the discussion is finished I move that a vote of thanks be tendered to Mr. Chollar, not only for his paper, but for the very interesting discussion which it has produced.

The President—I have no doubt Captain White is willing to include in that motion a vote of thanks to Mr. Humphreys for his contribution to the discussion of the paper.

Capt. White—I intended to cover that by including the very interesting discussion which had been produced by his paper.

The President—And also the story, I suppose. It is moved and seconded that a vote of thanks be tendered to Mr. Chollar and Mr. Humphreys for the two papers. (Carried.]

The Association then adjourned to Thursday, May 21st, 1896, at 10 A. M.

SECOND DAY—MORNING SESSION.

The Association met at 10 A. M.

The Secretary called the roll, the following members answering to their names.

ROLL CALL.

Honorary Members.

Barker, F. E., Boston, Mass. Hickenlooper, A., Cincinnati, Ohio.
White, W. H., New York. Humphreys, C. J. R., Lawrence, Mass.

Active Members.

Bauer, P., Texarkana, Ark.	Keller, C. M., Columbus, Ind.
Baxter, I. C., Detroit, Mich.	Littleton, A. W., Quincy, Ill.
Bivings, F. L., Birmingham, Ala.	Lynn, J. T., Detroit, Mich.
Blodget, C. W., Brooklyn, N. Y.	McDonald, W., Albany, N. Y.
Branch, A. H., Denver, Colo.	McIlhenny, J.D., Philadelphia, Pa.
Byron, T., Birmingham, Ala.	Miller, A.S., Long Island City, N.Y.
Chollar, B. E., St. Louis, Mo.	Miller, T. D., Dallas, Tex.
Clark, W., Philadelphia, Pa.	Morrell, E. E., Cicero, Ill.
Copley, I. C., Aurora, Ill.	Morgans, W. H., Pontiac, Mich.
Corley, J. A., Owensboro, Ky.	Murdock, J. W., Ottawa, Ill.
Cowdery, E. G., Milwaukee, Wis.	Odiorne, W. H., Springfield, Ill.
Cowdery, R. E., Topeka, Kan.	Perkins, B. W., South Bend, Ind.
Croul, J., Detroit, Mich.	Post, I. S., Chattanooga, Tenn.
Dunbar, J.W., New Albany, Ind.	Powell, W. E., Logansport, Ind.
Eaton, W. M., Jackson, Mich.	Printz, E., Zanesville, O.
Evans, C. H., Chicago, Ill.	Runner, Z. T. F., Freeport, Ill.
Ferrier, J., Columbus, Ga.	Salter, J., Covington, Ky.
Fitch, H. D., Bowling Green, Ky.	Sellers, W. B., Covington, Ky.
Forbes, J., Chattanooga, Tenn.	Shelton, F. H., Chicago, Ill.
Fullerton, G. Jr., Buffalo, N. Y.	Slater, A. B. Jr., Providence, R. I.
Gerould, H. T., Centralia, Ill.	Steinwedell, W., Quincy, Ill.
Greenough, M. S., Cleveland, O.	Taylor, G. H., Warren, O.
Harper, G. H., Altoona, Pa.	Thompson, G. T., New York City.
Howard, J. B., Galena, Ill.	Thwing, O. O., Milwaukee, Wis.
Humphreys, A. C., N. Y. City.	Walker, J., Port Huron, Mich.
Jenkins, E. H., Covington, Ky.	Warmington, D. R., Cleveland, O.
Jones, T. C., Delaware, O.	Young, R. Jr., Knoxville, Tenn.
Jones, C. D., Independence, Iowa.	

Associate Members.

Brown, E. C., New York City.	MacFarlane, G., Louisville, Ky.
Buss, J., Milwaukee, Wis.	Mauser, J. M., Royersford, Pa.
Callender, E. P., Little Falls, N.Y.	Morava, W., Chicago, Ill.
Collins, D. J., Philadelphia, Pa.	Mordue, T. N., New York City.
Dell, J., St. Louis, Mo.	Osius, G., Detroit, Mich.
Ellsworth, F. O., Chicago, Ill.	Persons, F. R., Toledo, O.
Goodwin, W.W., Philadelphia, Pa.	Randle, C. H., Chicago, Ill.
Gribbel, J., New York City.	Roots, D. T., Connersville, Ind.
Guldlin, O. N., Fort Wayne, Ind.	Roper, G. D., Rockford, Ill.
Harper, H. D., Chicago, Ill.	Russell, D. R., St. Louis, Mo.
Hayward, S. F., New York City.	Stacey, J. E., Cincinnati, O.
Helme, W. E., Philadelphia, Pa.	Van Wie, E. G., Detroit, Mich.
Higgins, C. M., New York City.	Wickham, L., St. Louis, Mo.

Mr. Jenkins—In connection with that I wish to read the names of some members of the Association with whom I have had correspondence, and who state that they are detained by various causes, from sickness or unexpected business matters, but who wish to be especially remembered to all the members of the Association here present: Irving Butterworth, J. W. R. Cline, James Somerville, A. S. Bushnell, J. W. Stratton, A. D. Cressler, C. R. Faben, and a number of others whose names I have not here and cannot recall.

LETTERS OF REGRET.

The Secretary here announced that letters regretting the inability of the writers to be present at the meeting had been received from the following gentlemen:

Addicks, W. R.	Highlands, S. M.	Pearson, W. H.
Bushnell, Gov. A. S.	Isbell, C. W.	Prichard, C. F.
Bradley, W. H.	Jones, E. C.	Ramsdell, G. G.
Bredel, F.	Kennedy, J. W.	Rawn, J. C.
Bodine, S. T.	Lathrop, A. B.	Stratton, S. S.
Christie, W. H.	Leach, H. B.	Sherman, F. C.
Egner, F.	McKay, W. E.	Thomas, J. R.
Gimper, J.	Norton, H. A.	Wilkiemeyer, H.

The President—Next in order will be the paper, by General Andrew Hickenlooper, on the subject of

MUNICIPALTIES VS. GAS COMPANIES: THEIR RECIPROCAL RELATIONS.

Gentlemen:

In addressing myself to the subject assigned me by your worthy Secretary—Municipalities vs. Gas Companies, and Their Reciprocal Relations—I must to a greater or less extent be governed by impressions derived not entirely from local conditions, or my own limited sphere of observation, but rather from the wider and more extended field covered by the membership of this Association.

From the time when Shirley, over 200 years ago, first discovered the inflammable character of the gases flowing from nature's laboratories in the coal mines of Wigan, on down through years of patient research and investigation by Hales, Lowther, Clayton, Accum, Winsor, Murdock, Clegg, Kirkham, Sugg, Livesey, and other still more eminent scientists and engineers, there has been no abatement in efforts to acquire knowledge and improve methods; nor has there been any decrease in public interest upon the subject of artificial illumination; every new discovery or improvement has been heralded as the dawn of a new era bringing to progressive civilization a new source of wealth and power.

Having established for itself the position of an important factor in material development, the problem next presented for consideration was the one upon which I have been invited to speak.

For over 80 years, ever since Sir Humphrey Davy and his associates of the Royal Society, ridiculed the feasibility of a general distribution of gas from a central station under conditions proposed by Mr. Murdock, and opposed as dangerous to the lives and property of citizens the construction of holders exceeding 20,000 cubic feet capacity, there has existed "an irrepressible conflict" as to the respective rights of municipalities and gas companies.

Under such circumstances it cannot be expected that I will be able to suggest a remedy, or do more than "blaze the way" to a better understanding of reciprocal relations.

I believe in the sacredness and inviolability of contracts, and the supremacy of law.

I believe that wisdom and intelligence should govern ignorance and superstition with a firmness and decision that cannot be misunderstood.

I believe in absolute equality of taxation; no one character of industrial enterprises should be taxed in excess of that of any other industry simply because it supplies a public want.

I believe in the granting of properly conditioned non-terminable franchises for the supply of a perpetual want.

I believe in the establishment of regulated industrial monopolies for the performance of any public service that can be as well, or better performed, than it can be through municipal agencies.

I believe that both gas companies and municipalities have obligations that should be observed, and rights that should be respected.

A monopoly is the possession of a privilege or right of exclusive sale, either through engrossment or special grant.

A virtual monopoly is defined as being a business so related to the great channels of trade and commerce that it becomes in a measure equivalent to a legal monopoly.

A regulated monopoly is one which to a certain extent partakes of the nature of a virtual monopoly, and is yet further controlled and governed by legislative or municipal restrictions.

Corporations are artificial persons created by, or under, authority of law from a group of natural persons; and having a continuous existence irrespective of that of the persons composing it.

There are various kinds and characters of corporations, but all having one common object, viz: the accomplishment of some special purpose which can be more conveniently, efficiently and economically performed through the instrumentality of such an organization than by individual effort.

A municipality is a municipal corporation, a body formed by authority of the State, authorized to act in an individual capacity through centralized power for the purpose of enhancing and protecting the best interest of the members—citizens—of the municipality.

A gas company is a joint-stock corporation, a body formed by authority of the State; empowered to act in an individual capacity through centralized power for the purpose of protecting and enhancing the best interests of the members—stockholders—of the corporation.

Thus municipalities and gas companies both derive their powers from the same source, are amenable to the same laws, and are governed substantially in the same manner. The former by the votes of its members centralizing power in a board of councilmen, with a mayor as executive officer, and the latter by a vote of its members centralizing power in a board of directors, with its president as executive officer.

Up to this point their legal status and public responsibilities are substantially the same; but here a divergency in their pathways is occasioned by the peculiar nature and requirements of our industry, involving, as it generally does, a contract for the supply of gas to the municipality as well as to private consumers, and always necessitating the occupancy of certain portions of the public property placed by the law under the exclusive control of the municipality—a right of occupancy absolutely necessary to the existence of the corporation. In no other way can a gas company be brought into existence except through the concurrent action of the municipality in which it is to operate.

Thus the public represented by the municipality becomes a party in interest, and it is but proper that such interest should be zealousy guarded and protected by municipal representatives, not in a spirit of antagonism or opposition, but rather with the feeling which should actuate partners interested in the same enterprise.

Admitting the power of control and regulation, vested in the municipality by legislative authority, it becomes the duty of these two parties in interest to decide upon and determine the terms and conditions of their reciprocal relations, which may be expressed in the form of a resolution, ordinance, or contract, either special or general, expressing the conditions under which the company may, for a given period of time, be permitted to occupy the public streets and conduct the business of supplying gas to the municipality and its citizens. This may be a very easy or a very difficult task, depending largely upon the character and intelligence of the men entrusted with negotiations requiring, not only business ability, but legal knowlege sufficient at least to comprehend the probable bearing and effect of suggested provisions.

Law is defined as "an express command; a fixed regulation." As it actually exists in modern society, it is the aggregation of rules by which a community regulates the conduct and rights of its members. An eminent statesman long ago voiced the sentiment that "a nation's laws and the intelligence of their administration unerringly portrays the character of its civilization." While this may be true, and we all know that the foundation principle of all government is that everybody must know, conform to, and obey the law; the principle is practically negatived by the fact that no one, not even the most learned and accomplished members of the legal profession, not even the judges upon the bench, always know what the law is or how, upon final hearing, it may be interpreted. In fact, like the industry itself, the laws which govern its existence and control its operations have been of slow development and growth; and not infrequently, like our work, has the new been built upon and tied into the old in such diversity of form as to make it difficult to recognize them as being in conformity with the requirements of the times.

Within the territory covered by the membership of this Association, there are about five hundred companies operating under franchises which were granted under varied and dissimilar, if not contradictory, conditions; and probably to over one-half of them at periods dating back over a quarter of a century ago when the industry was in its infancy, its future undeveloped, and the bearing and effect of legislative action but imperfectly understood. I may therefore safely assert that the terms and conditions of such franchises were, by neither of the contracting parties, as carefully considered, or as intelligently expressed, as they would be to-day. To this fact may properly be attributed much of the trouble and annoyance subsequently experienced in properly interpreting the contract obligations and reciprocal relations of municipal and industrial corporations. Though, even with the experiences of the past and knowledge of the present to guide us, it would be difficult to draw any contract which would stand the test of legal interpretation, and for all time be regarded as accurately defining the relations which are to be maintained.

While we all know that declarations of intentions made after the execution of an admitted contract are incompetent as evidence to prove its meaning, we also know that it is a well established principle of law that the subsequent acts of the parties under such contract are not only admissible, but ordinarily conclusive, in establishing the meaning of ambiguous terms.

Justice Matthews in rendering a decision of the United States Supreme Court said:—

"If there were any doubt or ambiguity in the words employed in the clause of the contract under consideration, it would be effectually removed by the practical construction continuously put upon them by the conduct of the parties for so long a period."

In the face of such facts and conclusions, the uncertainties of law were never more clearly illustrated than in a case recently brought by the company I represent against the city of Cincinnati.

The proper interpretation of the single word "lowest" in connection with the word "average" inserted in our original contract, was the cause of an annoying and expensive contention and litigation.

Notwithstanding the fact that for a period of fifty years both parties to the contract had by their acts given to its meaning a certain interpretation, and the further fact that two subordinate courts, after most exhaustive trials extending over a period of six weeks, had rendered decisions giving the word an interpretation in harmony with the acts of the parties, when it came to the Supreme Court of the State; this court, the members of which could not themselves agree upon the meaning of the words used, decided by a majority vote that there was no ambiguity in the language expressed; reversed the former decisions, and placed an entirely different interpretation upon the terms of the ordinance.

Less legal and legislative talent, and more practical common sense, should be invoked by both parties in determining the proper business relations which they should sustain toward each other.

When David Dudley Field, the greatest law reformer of the age, failed to secure through the legal profession the reforms which he deemed necessary to meet the demands of advancing civilization, he turned successfully to the Commercial Clubs, Chambers of Commerce, and Boards of Trade for aid in the accomplishment of his purposes. When the wisdom of such a course is more generally recognized and the public can be made to see that such methods will lead to an earlier and more satisfactory termination of contentions, we may hope for a new spirit to move and direct the settlement of business questions.

In "a government of the people, for the people and by the people," public opinion is the court of last resort, and the masses are the ones most in need of educational influences; they are the sources of power through whose action men are elected to their councils to represent and promote their interests. As no fountain can rise higher than its source, so no government can benefit the people beyond the limit of their intelligence. They must be taught to realize that ignorance is the subservient slave of cupidity; that failure to wisely exercise the right of suffrage in behalf of intelligence lays the foundation for many of the wrongs of which the people justly complain. That it is their own fault if men are elected to representative positions who are incapable of an intelligent understanding of the subjects which they are called upon to legislate, and hence while well meaning and willing, may be incapable of securing for their constituents all the advantages to which they are justly entitled. What we need in such positions are men familiar with the practical business affairs of life; men who cannot be swayed by the ever changing phases of public sentiment frequently moved and directed by the selfish motives of adverse interests.

If the representatives of municipal government are ignorant, weak or incompetent, it is because the citizens are indifferent to such conditions. Therefore, carefully foster the influences which tend to the social, moral, and educational advancement of the masses who, by their votes, determine the character of the men who have it in their power to shape the destiny of our nation.

Every community is composed of three general classes, the good, the bad and the indifferent; and the representative portion—councilmen—with whom our companies are brought in more direct contact, are neither better nor worse than the average of the citizens they represent; usually consisting of about equal proportions of good citizens, professional politicians, and citizens who are *very* good. This order of classification representing their respective merits.

The first named being the plain common-sense business man, possibly not always as intelligent as he should be in regard to municipal needs and requirements, but generally guided in his course by a sincere desire to be perfectly fair and honest, though not always proof against the secret and subtle influences which are not infrequently brought to bear to shape and control legislative action.

The second is a representative of the purely political element of the community; usually the brightest, best posted, and most skilful controller of public sentiment, and manipulator of legislative proceedings; by all odds the best equipped for good or evil, but usually unmindful of the grave and responsible duties of true citizenship when engaged in the more congenial occupation of studying party interests or the possible effect of any measure which has

not previously received the approval of the men upon whom he depends for political preferment.

The third are the class that burdens every community with their impracticable theories and visionary ideas of municipal reform. So engrossed in the contemplation of their own immaculate virtues that they would willingly have the wheels of progress stayed rather than do violence to their own pet theories, or give justice to anything that bears the stamp of so-called monopolistic tendencies. Their constant effort being to inculcate in the minds of the masses the belief that any act of injustice or oppression which can be made legal is inherently right; thus giving to "legalized robbery" an interpretation of much more significance than is usually attributed to it.

Upon the other hand, the men who are the leaders in and promoters of industrial undertakings, are generally the most active, wide-awake and enterprising men in the community, actuated by an honest desire to enhance the conveniences, increase the attractiveness, and improve the business advantages of the municipality upon the growth and prosperity of which they must depend for the success of any dependent and contributary industry; and the ones whom they select to serve them as directors in the management of the affairs of the corporation are those who possess that distinctive business and executive ability which gives promise of success in the managment of the industry entrusted to their care.

Thus upon one side are arrayed the forces inspired to action by the hope of pecuniary gain, and upon the opposite side the powerful influence to which we have briefly referred, strongly entrenched behind barriers of prejudice, needlessly erected and unjustly maintained.

The problem to be solved is how best to harmonize these apparently conflicting interests; how best to control these opposing forces in order that their powers for evil may be eliminated, and their powers for good be developed.

Intelligent consideration and discussion are the only weapons to be used, their points may be broken and keen edges turned by the armor of selfishness and superstition, but eventually they will penetrate some weak spot and let in the light of reason.

Webster defines "honesty" to be "acting and having the disposition to act at all times according to justness and correct moral principles."

If all men were "honest" there would be but little difficulty experienced in inaugurating and maintaining the most harmonious relations between the contracting parties, but unfortunately such is not the case. While I hesitate to assert that there are no honest men in the world—for I am personally a believer in the innate honesty of mankind when not too strongly influenced by personal or selfish considerations—under such an accepted definition as that given by Webster, I am forced to the conclusion that honest men are "the exception and not the rule," for the simple reason that few are entirely free from the powerful influence of pecuniary gain, corroding jealousy, popular prejudice, communistic sympathies or superstitious fears.

It may very properly and truthfully be claimed that the representatives of industrial corporations are mainly influenced by the hope of pecuniary gain; such a fact cannot, and should not be denied, concealed, or disguised. While it may be true that "money is the root of all evil," it is equally true that hope of profit is the mainspring of all human effort. The power to create and the right to enjoy profit, are the only stimulants to exertion; men labor only so long as they are inspired to action by hope of reward; abrogate this incentive to accumulate, and you destroy the desire to labor. Capital is but the product of applied energy, the evidence of the reward of labor; whenever it is most freely invested, there you will find the greatest evidence of enterprise and progress. The hope of profit is the only thing that lures capital from its hiding places; deny it the right of profit and it will lie dormant, and thus stay the wheels of progress. The great bridges that span our mighty rivers, the iron trackways that cross and re-cross the continent, the stately ships that carry the commerce of the world, are but the products of enterprise stimulated by the greed of gain. The only men who labor without hope of pecuniary reward are slaves, and slavery has never yet contributed to the well being of mankind. Why then should the representatives of the industry in which we are engaged, deny or attempt to disguise, this incentive to aggressive action? It is a matter of acknowledged publicity for which due allowance can, and always has been made.

Upon the other hand, in the mind and heart of every human being, there appears to have been installed a certain degree of jealousy of another's success, a feeling confined to no sect, religion or station in life; all alike, from the untutored savage to the crowned ruler, have felt its sting; and apparently the wider the field of opportunity, the more intense the feeling of disappointment and resentment upon the part of those who have failed to reach the goal.

The periodical outbursts of dissatisfied labor are not always the result of unjust or oppressive action, but are apparently more frequently the escape valve for that restless and dissatisfied feeling which appears to be inherent in every human mind, a longing for some change of environment or condition not founded upon reason.

So, apparently, are the periodical raids made against gas companies which, though frequently inspired by selfish motives and voiced by intelligent leaders, are usually but the resultant efforts of the same unaccountable conditions of mind partially attributable to the fact that this is an age remarkable for its rapid changes in business methods. The day of small things has passed away, and in their places we find a growing tendency toward divisibility of labor and concentration of effort.

The old economic theories were founded upon admitted competition and incidental multiplication of the industries with their attendant inefficiences and waste. The new system is based upon concentration and combination, decreased cost of production and increased intelligence in business management.

It is but natural that this commercial and industrial revolution should produce friction. It has been so from the beginning of time, and will be so to the end. The substitution of turnpikes for dirt-roads was resisted by mobs plowing up the metal and burning the toll-houses. The introduction of sewing machines was resisted because of the belief that it would take bread from the mouths of the garment-makers, and add to the unemployed. The steam railroads had to fight their way step by step over the opposition of those interested in stage lines. Telegraph lines have been cut through ignorant superstition that they robbed the farmer's crops of needed vitalizing forces. The spinning-jenny was knocked to pieces because it took the place of the old hand-loom. The men who had the temerity to portray the social, moral and industrial advantages of the abolition of slavery were denounced in public places and hunted like wild beasts from cover to cover. Even in my own city the men who advocated the introduction of the steam fire engine and a paid department were hung in effigy, and hooted at on the streets.

The man who aided in the destruction of improved machinery because it necessitated a change in industrial conditions, and the young buffalo that locked horns with the locomotive because it had invaded his grazing grounds may have felt that they were justified in their opposition, but they were not wise in their day and generation. In fact every step in the world's progress from barbarism to advanced civilization has been but a long continued struggle between energy and intelligence upon the one hand, and ignorance and improvidence upon the other.

The opponents of progress, under whatever banner enrolled, have announced, as the controlling principles of their campaign, opposition to concentrated capital and the establishment of so-called monopolies; and on lines which affect our special industry, to the advocacy of open competition, municipal ownership, and governmental paternalism.

The leaders in the crusade are generally theorists who have developed sentiment at the expense of judgment based upon experience, the poor who feel the sting of poverty and imagine that there is some undiscovered royal road to wealth, or the scheming politician who realizes that widening the scope of political patronage increases the number who will thereby become dependent upon his political pull.

Wealth is but accumulated savings from previous efforts, and, therefore, the first and all essential requisite toward a solution of the economic problem is to spend less than you earn. This accumulation is capital, it has an earning power, and grows while the possessor is sleeping. When it attains an earning capacity equal to wages formerly earned, the posessor may cease labor, and thereby become a capitalist. It is an error to suppose that the concentration of wealth impoverishes the masses; this might be true if there were no difference between consumable and productive wealth. The former withdraws from the channels of trade and commerce, while the latter but adds to and stimulates enterprises through which increased opportunities for employment are given to the masses. Deny the right to accumulate wealth and combine capital, and all

great accomplishments must cease. Our traffic lines would soon become but streaks of rust and rights of way; our ships would be rotting at their wharfs; our warehouses would become but shelters for the army of the unemployed; individual would take the place of combined effort, and savagery would come again.

Labor itself establishes the principles of monopoly when it insists that opportunities for employment shall be afforded only to a certain class, that an employee shall not be discharged for the purpose of giving his place to another, and frequently goes still further in demanding that even a vacancy created by voluntary act shall not be accepted by another who was no party to the cause of the vacancy. Aye, still further, in demanding that an employee shall not be discharged in order that his place may be filled by another who is willing to render the same service at a less price, and thus organized labor finds itself determinedly arrayed against competition.

While "monopoly" has been regarded with suspicion by some and earnestly condemned by others, greater familiarity with its purposes and accomplishments has to some extent modified public sentiment. Even Prof. Ed. W. Bemis, who was quite recently engaged by a labor organization to deliver a lecture in Cincinnati entitled "Municipal Monopolies and the People's Rights," said:—

"Workingmen are supposed to applaud whenever monopolies are denounced. It is much easier to clap one's hands than to set the brain to work to advance civilization, and such advance is inseparably connected with "Monopoly." In my days of ignorance I was taken with the idea that monopolies were the oppressors of the people, but the longer I live and the more I study people as well as theories, the more clearly I see that the wealth acquired by monopoly is the accumulation and the fitting reward of shrewdness and energy, and that the kicker at monopolies is simply kicking against the very means by which we have progressed out of barbarism."

Against corporate organization the feeling becomes more intense as this form of aggregating wealth becomes more and more successful through accumulation, concentration, and combination; generally finding expression in a desire upon the part of the masses to share in the profits of successful enterprises, either directly or by means of various legal enactments providing for pecuniary concessions or enforced taxation, regardless of the fact that every act of independent venture is accompanied by risk, and that it is only through assuming this chance of loss, that the right of profit is equitably assured.

I do not agree with the sentiment expressed by a champion of organized labor—E. E. Hutchins—who, at a meeting recently held in Cincinnati, said:—

"The right of a man to conduct his own business as he sees fit under the law we will not now question; but whenever that man asks another to aid him in his work or business it no longer belongs to him alone, profit then becomes the product of joint effort and each contributor is entitled to his share.

"The employer and employed are now far apart with practically nothing in common, indifferent disdain upon one side, and bitter antipathy upon the other."

Love begets love and interest begets interest; antagonism upon one side will never create interest upon the other side; all should unite upon the broad plain of mutuality of interests, which can only be accomplished through an intelligent understanding of respective rights.

While independence should be the commendable desire of every American citizen, he should be educated to realize that such a condition cannot be attained by tearing down and destroying agencies of progress, or by restricting industrial effort to the pace set by the least industrious and enterprising; the brain-worker and the hand-worker are each entitled only to compensation fairly proportionate to the value of their respective services.

Never has there been a period in the world's history when so many concessions have been made to labor, or such thoughtful care been exercised by the employer for the welfare, protection, and advancement of the moral, educational, and material interests of the employed. Our incomparable common school system, extending even to a university education, our thoroughly equipped hospitals, free dispensaries, technical schools, mechanics institutes, art schools, free museums, lecture halls, public libraries, Christian associations, and other kindred beneficent institutions, all testify to the freedom with which those who possess have contributed to the well-being of the less fortunate in life's struggles.

Not only does this properly portray capital's interest in labor, but the tendency of all legislation is now to limit the profit that shall go to the employer, and increase the compensation that shall be paid to the employed. Instead of monopoly growing in political power and influence, whether justly or unjustly, its encroachments are so feared by the masses, that any aspirant to political honors would regard its open advocacy as equivalent to signing his own political death warrant.

There is no denying the fact that many abuses have resulted from concentration and combination, but they are incidental and not necessary to such conditions. It is a characteristic feature of all new developments that abuses creep in which it takes time to eradicate; to do this is the true function of intelligent statesmanship.

It is not true that the concentration of capital destroys competition in its broadest sense, it only changes the plan and intensifies the struggle between stronger contestants. It undoubtedly tends to increase volume and reduce cost of production, for almost the entire profit now derived by concentrated industrial enterprises comes not out of the consumer, but from greater economies in production, and mainly through the utilization of that which a few years ago was regarded as necessary waste. It certainly reduces prices and enhances opportunities for employment and increases the wages of skilled and intelligent workmen.

The most distinctive illustration of these conditions in their relations to monopoly is afforded by the history of the Standord Oil Company, which for ten years has practically had no opposition, and yet, while prices of its products have varied, they have steadily tended downward.

Declination to share business profits with those who are unwilling to assume its risks is usually followed by unintelligent denunciation of all industrial enterprises as monopolies, regardless of the fact that the municipal corporation which they themselves represent and are serving, is a political and industrial monopoly of the most pronounced type, created by the state for the purpose of serving the best interests of a group of individual persons in their collective capacity, in order that they may secure the advantages of associated power in improving their political, social, commercial and industrial relations.

In fact no state legislature can create a municipality without, at the same time, creating a monopoly; and no municipality can be authorized to perform an industrial service without creating an industrial monopoly.

Monopoly, as applied to industrial management, means the possession of rights, privileges and powers greater than can be acquired by individual effort; therefore in the presence of such a power, it is not unnatural that the unintelligent and superstitious legislator should tremble with apprehensive fear for the safety and perpetuity of that control of which he himself desires to retain a monopoly. As applied to production and distribution, it means the right to exclusive possession and disposal of a particular product, but no such rights can be acquired or maintained in regard to the general purposes and methods of illumination. Gas is but one of many instrumentalities for accomplishing the same purpose, and cannot therefore, in the full significance of the term, ever be regarded as capable of maintaining a monopoly.

I am clear in my judgment that every gas company should be permitted to enjoy a monopoly of its product within the limits of any single municipality, or within the range of a single company's ability to supply; but I, at the same time, freely admit that if any existing industry should be uncontrolled, either by legislative or municipal restrictions, there would be grave danger that injustice might be done the public through exorbitant charges for an article which has grown to be regarded as a public necessity; but in every state of the Union the prices of gas have been fixed either by legislative authority, municipal action, or concurrent agreement between the producer and consumer, and thus our industry can but become a "regulated," the most harmless of all monopolies.

One-half of the people of the civilized world are now living in towns and cities, and the ratio of the urban to the rural population is constantly increasing throughout the world. More and more will this tendency increase as these centers more and more represent the intellectual life and activities of a progressive people. But to these centers of wealth and enterprise are also gravitating the poor, helpless and vicious; the dregs of society; supplemented by the representatives of nationalism, socialism, and communism; each and all imbued with the idea that the world owes them a living, and that such living can best be acquired through either an enforced redistribution of accumulated wealth, or governmental paternalism

that will afford nominal employment coupled with abundant compensation.

In advocacy of paternalism they are taking a step backward to the time when the English government attempted the maintenance of such a system by bounties to losing, and taxes upon profitable undertakings; certain industries forbidden, and others encouraged; measures to protect labor, and regulate wages; enactments to fix prices, and determine profits; laws to control production and limit sales; all these and kindred paternal measures resulted not in the elevation but in the pauperism, of British subjects.

"That government is the best which governs the least," certainly in so far as matters are concerned which pertain to individual freedom of action in the development of industrial enterprises which enlarge the field, or broaden the scope, of either brain work or muscular power.

The true functions of government are limited to the promotion of intelligence, care for the unfortunate, protection of life and property and establishment of equality of justice in all things. The moment it goes beyond this, and enters the domain of private enterprise, it robs the citizen of his right of election as to the disposal of his surplus, and forces him, whether willing or unwilling, to contribute through taxation the capital necessary to inaugurate the undertaking.

The law that protects intelligence in its rights to dispose of surplus earned, equally protects the poor in the enjoyment of their fair proportion of the result of joint effort; any failure to do this wrongs all, but none more so than the one who has the smallest surplus saved.

Any law which tends to the abridgment of industrial freedom, curtails the sphere of individual action, or relieves men from personal responsibility for their own support, inevitably paralyzes independent personal effort for the betterment of their condition. All the progress that has ever been made from poverty to wealth has been brought about by widening the field and scope of individual action and individual responsibility. Every man should be taught to be self-supporting, to regard dependence upon others as a disgrace and that those who attempt to live without labor are enemies of society.

It is true that God has decreed that "man shall earn his bread by the sweat of his brow," yet how few realize that while the sweat that is discharged upon the outside evidences the expenditure of physical energy, there is a sweat upon the inside that equally represents the expenditure of brain force. Intelligence is the tool used, and muscular power the energy applied; both essential to the successful accomplishment of any purpose, and yet the one who utilizes the least brain force and the poorest tools, is the one who accomplishes least in the great struggle of life, and the one who merits and receives the least in return for services rendered.

Municipal ownership is a condition of political paternalism advocated by labor agitators and moral reformers, who, paradoxical as it may seem, just as loudly and earnestly denounce the corrupting influence of political patronage, and who just as inconsistently and unintelligently advocate it as an economical measure, and in doing so pervert facts and falsify records with a freedom and boldness that indicates an entire absence of moral responsibility.

It is essential to a correct and comprehensive comparison of the relative economies of municipal and private ownership and administration of industrial enterprises, that not only should every item of expense of operation, administration, maintenance, contingent and fixed charges, which find their way into the accounts of any well managed industrial enterprise be charged by the municipality; but also that the losses in income due to municipal control shall appear upon the debit side of its accounts. In other words, that for all services rendered there must be a charge, and all incidental losses of income must be regarded as an expense, in order that the comparative economic results may be so clearly shown that they cannot but be accepted as correct by both those who oppose and those who advocate municipal ownership.

Add to this the loss of income or consideration, which a private corporation would be willing to pay if permitted to uninterruptedly enjoy the same rights, privileges and immunities which a municipality concedes to itself, viz: *an exclusive, unrestricted, untaxable and perpetual franchise*, and there will no longer be a doubt as to which will prove most advantageous to the community.

If such service cannot be as well or better performed by or through such industrial agencies, then I am ready to admit the converse of this proposition to be true; but I wish it distinctly understood that this admission applies only to the rendition of a strictly public service, and not to the supply of a private want.

Judge Dillon, in his great work on Municipal Corporations, says:—

"To clothe municipalties with powers to accomplish purposes which can better be left to private enterprise is unwise. To invest them with the powers of individuals or private corporations for objects not pertaining to municipal rule, is to pervert the institution from its legitimate ends and to require of it duties it is not adapted satisfactorily to perform."

I believe it the height of folly for the government to interfere by participation in the commercial or industrial business of the country, or to undertake the performance of any duty other than the enforcement of laws enacted for the moral advancement and police protection of the government. The moment it steps beyond these limitations, it assumes duties and responsibilities not in harmony with the purposes of its creation, and forces every citizen, whether willing or unwilling, to contribute by taxation the capital necessary to inaugurate the enterprise.

If such an enterprise be operated with profit, that profit is the measure of the sum exacted beyond cost, and thus becomes a special tax upon the consumer for the benefit of the general public. If operated at a loss the general public must make up the difference, and thus the non-user must pay a portion of the consumers' bills. If operated so that there will be neither profit nor loss, the public must pay the difference between the cost of a public and private rendition of service.

In either event it is an unjust burden placed upon either one, the other, or both.

If the same service be rendered by a private industrial corporation, the general public makes no contribution toward inaugurating the enterprise; if unprofitable the stockholders alone bear the loss, and if remunerative the consumer alone pays the profit; it is not a matter in which the general public is interested one way or the other.

It is therefore a surprising fact that while not exceeding one-fourth the citizens of any city are consumers of gas, and they generally, the most intelligent and wealthy portion of the community, they are seldom advocates of municipal control; while among the less intelligent and poorer classes are to be found the most earnest advocates of a theory that cannot but force upon them burdens to which they are now strangers.

There can be but one justification for, as there is but one legitimate argument to be made in favor of municipal control, and that is that any such character of service can be more efficiently rendered and at less expense through the instrumentality of municipal agencies than through the agency of a private industrial corporation.

Does any one believe that any form of municipal control insures a better and more faithful rendition of service than that required by the controllers of industrial corporations? Will any one claim that the financial affairs of municipalities are more judiciously and economically managed than are those of industrial corporations? Can any one consistently assert that the influences which secure the appointment of the superintendents of the several departments of a municipality are as pure, competent, and intelligent as are those which govern the selection of those occupying corresponding positions in industrial corporations?

How inconsistent then appears the position of men who loudly and unintelligently decry the establishment of industrial monopolies to be managed by the most experienced and capable men, and yet advocate in their stead the establishment of municipal industrial monopolies to be managed by men admittedly unfamiliar with the duties to be performed, and accountable alone to the political party in power.

Nationalists have to-day before the legislatures of nearly every state in the Union, petitions demanding that not only shall the government acquire, own, control and operate all railroads, telegraph, telephone, electric light and gas companies, but shall also construct free turnpikes, build houses, rent homes, and lend money; apparently never realizing that it is the people who must contribute to support the government, and not the government to support the people.

While thus demanding governmental protection and assistance, these class reformers would deny equal protection for all other classes.

Henry George, at a meeting held in Cooper Union Hall, New York City, on the 28th of last February, said:

"I would rather see every locomotive thrown from the tracks, every rail torn up, and every car broken, than to see order preserved by the bayonet of a standing army."

In reply to which I will now say, as recently said Rev. F. W. Gunnison:

"I would expend every power of armed government to put down the idea that one set of men shall demand successfully that some other set shall not work at a task which the first have declined.

"The flag of the Republic better be placed by the hand of undisputed authority upon every car which a mob dares to detain, or threatens to destroy, and when that flag is touched let the iron lips speak the supremacy of law."

The purpose in granting any quasi-public franchise is not only to create a private right, but also to fill a public want. While ordinarily considered a valuable concession to the promoter, may it not also, in many cases, be regarded as of equal, if not greater, value to the municipality that creates it? Is not the sum that any city would be willing to pay rather than be deprived of the benefits and advantages of the product it supplies, the measure of its value to the community it serves? Does not the city as a whole receive its fair proportionate compensation through the incidental advantages thus indiscriminately bestowed? The price at which any service is ordinarily rendered, or any manufactured article generally sold to the consumer, is the gross cost less a fair profit upon the capital thus invested; capital will either exact this profit for use and risk, or seek other channels of investment.

I therefore regard the public sale of such franchises as the height of uneconomic wisdom, the least meritorious of all the theories from time to time advanced in regard to the establishment and control of industrial undertakings.

Any special bonus exacted, or tax imposed, upon a producing industry adds just that much to the gross cost of production; and exactly to the extent of such addition becomes a special tax imposed upon the consumer for the benefit of the non-user.

Any consumer of gas who approves of this form of taxation and votes to sustain such a measure, thereby agrees to reduce the taxation upon non-consumers and generously pays the difference out of his own pocket.

The true economic policy would be to grant the franchise to the party offering to perform the desired service at the least cost and expense to the user.

While the representatives of every enterprising municipality are forced into a recognition of the necessity of providing for its proper illumination, that undefined and superstituous fear of monopoly again steps in to prompt the legislative error of limiting the life of an industry that is to supply a perpetual want, in place of providing for perpetual life and periodical regulation.

Terminal franchises are in my judgment the quintessence of uneconomical wisdom. To justify the best construction, highest efficiency, and greatest economy in operation, measures which are of as much importance to the consumer as producer, there must be an undisputed and perpetual right to supply. While this character of franchise—supplemented by the right of periodical regulation—gives to the city and its citizens all the protection they can reasonably or honestly desire; it at the same time gives to the investor that certainty of tenure which alone induces the investment of capital in the most permanent and enduring structures and efficient apparatus, and encourages efforts toward building up a satisfactory and prosperous industry, even though its projectors have to look to the future for an adequate return.

Justice Davis in rendering his famous decision in the Binghamton case said:—

"The Legislature says to the public-spirited citizen, if you will embark your time, money, and skill in an enterprise which will accommodate a public necessity, we will grant to you for a limited period, or in perpetuity, privileges that will justify the expenditure of your money and the employment of your time and skill.

"Such a grant is a contract with mutual considerations, and justice and good policy alike require that the protection of the law should be assured to it."

No private manufacturing enterprise would for a moment think of locating a permanent and expensive plant in any place, or under any conditions, which would give rise to even a remote possibility of having their right to continue the business limited to any given period of time.

What reasons are there for supposing that quasi-public corporations can better afford to erect plants, that frequently exceed in value the most expensive of private constructions, and for an adequate return upon which investment they not infrequently have to wait for years, and the possibility of future developments, without having some reasonable assurance of permanency of tenure?

Laws that force upon industrial corporations franchises for a limited period of time entail upon their projectors and operators extraordinary expenses, and upon their patrons excessive prices, to the end that their promoters may not only be compensated for services rendered, but that they may obtain an equivalent for possible loss of investment through expiration of grant. And yet so great is the superstitious dread of accumulated wealth and corporation power in the minds of the less intelligent and well informed of every community that they are swift to oppose even measures calculated to contribute to their own welfare and pecuniary advantage.

The Street Railway Company of Cincinnati recently submitted for the consideration of the Ohio Legislature a bill which simply authorized that city if in its wisdom it should see proper so to do, to grant a franchise for a period of not exceeding fifty years, subject to such conditions and restrictions as the municipality might see proper to impose.

The mere suggestion of such a just and equitable measure was sufficient to arouse the violent antagonism of the "Washington Reform Club" of Cleveland, the president of this modern "reform" organization in wild frenzy exclaiming:—

"If any representative from Cleveland votes for such a measure I will join a crowd to hang the guilty member to the most convenient lamp post."

And another equally enthusiastic "Washingtonian" exclaiming:—

"As an American citizen I too will be one who will help to string up any man who shall by his vote sanction any such damnable scheme of robbery."

Language that, in this enlightened age, disgraces intelligence and insults Americanism.

No community is in a healthy condition which is represented by men who are so saturated with the poison of communism as to denounce the acquirement of wealth as detrimental to progressive civilization, or is so overcome by his sympathies for the unfortunate that he believes in any form of legal enactment which levies tribute upon the intelligence and enterprise of one class of citizens for the benefit of another class who have displayed no such capacity to benefit themselves or the community in which they live.

Business activity and sympathetic charity are each commendable in their own sphere, but seldom pull well together in building up a country, in fact the decay of the fabric may some day be brought about by too close a commingling of these forces.

George Stephenson, the first builder of railroads, said, and the saying has become an axiom in political economy, "when combination is possible competition is impossible," and I may add that if competition is unadvisable, monopoly cannot be objectionable, and therefore exclusive franchises must be admissible.

Theory, reason, experience and common sense all conclusively prove that the interests of the public are best subserved by adopting as a principle of legislation consolidation, and not competition, in the manufacture and delivery of gas.

John Stuart Mill, the greatest of all political economists, many years ago, gave expression to his views upon this subject, saying:—

"When a business of real public importance can only be carried on advantageously upon so large a scale as to render the liberty of competition almost illusory, it is an unthrifty dispensation of the public resources that several costly sets of arrangements should be kept up for the purpose of rendering to the community this one (gas) service.

"It is much better to treat it at once as a public function, and if it be not such as the government itself could beneficially undertake it should be made over entire to the company or association which will perform it on the best terms for the public."

Many years of dearly bought experience have fully confirmed the wisdom of his conclusions.

Can the justness of the proposition be denied, when any community has granted to an industrial corporation certain rights, franchises and privileges, on the good faith of which the capital of its citizens has been invested in a shape that will not admit of its being recalled or devoted to other purposes, that it is the paramount duty of the municipality to protect that industry as it would protect itself, from oppressive enactments, or destructive competition?

While this principle is applicable to all industrial enterprises it has a peculiar force when applied to a commodity that has become a public necessity, and the introduction of which contributes to a

greater extent than any other one thing to the health, wealth, growth and prosperity of the municipality in which it is located.

In the face of this expressed opinion by the greatest expounder of the true principles of political economy that ever lived, and in the face of the fact that the unbroken history of all the years that have passed, presents a uniform confirmation of the correctness of the assertion, that there is not a single city, town, or village in the land which has succumbed to the persuasive wiles of the "raider," that is not to-day, in high prices and unnecessarily duplicated capital, paying the penalty of such unintelligent action, can any one consistently claim that the remedy for any real or fancied dereliction of duty lies in the direction of permitted competition?

It appears unnecessary for me to extend my remarks upon this phase of our subject, further than to say that if injustice is done by a municipality, the law of self-preservation comes into play and the inevitable result must follow. If the opposition cannot be crushed or bought, uniform rates will be established or territory will be divided, and prices increased to compensate for former losses and to pay dividends on uselessly duplicated capital; leaving only to deluded citizens the pleasure and consolation of paying increased tribute to two monopolies instead of one.

When this measure of intelligent self-protection, absolutely necessary to the continued life of the industry, has been inaugurated, the baffled and disappointed representative again invokes legislative action with the hope of being able to devise some other method of repudiating the legal, if not the moral, obligations of the municipality, usually through some scheme by which the rewards of the enterprise, toils, and risks of the promoters of these special industries shall be taken from them and be applied to other uses for the benefit of the general public. Or failing in this, to load the industry down with burdens of restrictions and taxation calculated not only to impair vested interests, but destroy its usefulness to the community it was organized to serve and he is supposed to represent.

We cannot but admit, that if the business upon which it is proposed to place the burdens of a special tax is of such a character that it gives special advantages to the few, or imposes burdens upon the general public in the way of occupying territory that might otherwise be profitably utilized, caused the destruction or impaired the permanency of streets or other municipal property for which the general public has paid, or in any manner interfered with the free conduct or enjoyment of other business interests, a compensating special tax would be eminently proper; but no such condition now exists, or can arise, in conducting the business of the corporations under our charge.

It must not be forgotten that the state or municipality is but aggregated citizenship, and any tax necessary for its support should be so levied as to bear alike upon each and all,—that it should be uniform and without discrimination. Can it be consistently claimed that a special tax upon one character of industrial enterprise from which others are exempt, would be equitable or just? From such a condition of oppression it has but one avenue of escape—even if that has been left open—and that is, to add a corresponding and compensating price for their manufactured product. If this is done, such a tax becomes but an added burden upon the patrons of the industry.

No community is benefitted by imposing burdens upon industrial undertakings; upon the contrary it but benefits all classes of citizens by liberalizing, protecting, and encouraging the growth and development of enterprises to the establishment of which its own citizens have contributed their time, influence, knowledge and capital.

The aggregation of capital under corporate organization is constantly increasing, and individual effort is daily becoming more dependent upon movements which combine labor and capital. It appears to be but the natural development of the times in obedience to some natural law or economic advantage, and all attempts to arrest this form of progress will be in vain so long as it can be shown that through such agencies the interests of the public as well as the promoters, are equitably guarded and mutually benefitted.

The universal interest manifested by all classes in every community respecting the policy, rights, privileges and obligations which should govern and control such combinations, is evidenced by the frequently expressed desire for legislative protection from evils which they believe exist and which they thus seek to lessen or eradicate. These are the questions to which the ablest minds are now addressing themselves and seeking to determine how best to adjust and direct the efforts of co-operative action or combined production, so that its resultant benefits may be most equitably enjoyed by each and every citizen of the community.

Legislative bodies are the duly accredited representatives of the people, and as such have neither the legal nor moral right to grant any power through the agency of which excessive profits may be exacted from the many for the benefit of the few, and therefore any law enacted, or privileges granted, should be so guarded as to reserve to the people such rights of control as will enable their representatives to enforce the conditions of the grant in order that they may have the fullest possible protection against excessive charges, or the improper or inefficient performance of contract obligations. This is the right of the people and the true interests of the corporations.

If any such franchise already granted does not contain adequate provision for the protection of public interests, is the granting power now powerless to remedy the evils of its own neglect or the State's creation? If so, it has certainly divested itself of that power of control which it would have been the part of wisdom to retain. That experience has taught the wisdom of such a conclusion is evidenced by the evolution of legislation which, in revising State constitutions of recent date has eliminated the power to grant irrepealable franchises, and substituted the unalterable condition that any such franchise or charter may be altered or repealed at the will of the creating power, either through judicial forfeiture, that determines corporate misconduct; or made subject to amendment for the reason that legislative views as to State policy have radically changed.

This may appear like an arbitrary power liable to be exercised to the prejudice of corporate interests, but the character of the grant being clearly defined before acceptance, the just exercise of the right can carry with it no just charge of violated faith.

When a gas company receives from a State or municipality a franchise with special privileges and grants of power, it does so with the understanding that it has been bestowed for the purpose of subserving public interests, as well as creating a private right: both form the foundation principles of the contract to be observed.

In practical and judicial construction it must, however, always be assumed that neither the State nor the municipality intended to give anything not expressly stated, and the corporation has secured in the express terms all it desired to obtain. A misplaced semicolon in two or three sections of the tariff law led to legal decisions which gave to Great Britain a monopoly of the tin-plate industry, and in another instance caused thousands of dollars to be refunded to importers of women's hat-trimmings, though the intent of the law was perfectly plain. Therefore the greatest possible care should be taken in the use of the words best calculated to clearly express the intention of the contracting parties; failure to do this has been, and will ever be, one of the main causes of the annoyances and contentious litigations to which our industry has been subjected.

Whether such service shall be rendered through the agency of a political or industrial monopoly is for the State to determine, but when once determined, all the force and power of the State should be given to its support and protection. When charters have been granted without the reserved right of amendment or repeal the State must stand by its acts, and the corporation must operate according to the provisions of the grant or forfeit their privileges.

"Laugh and the world laughs with us, but weep and we weep alone" is a truism we may with profit acknowledge by turning our backs upon the past, and try in the future to so shape, control, and direct our industry as to decrease the evils of which, either we ourselves or the public, justly or unjustly, complain. We must recognize the fact that government is but society organized for the good of the whole, even at the expense of individual interests.

How far the activities—socialism if you please—of municipalities may be safely permitted to go in the character of paternal government, is the problem yet to be solved, though Macauley says "paternalism is a doctrine in which we shall not believe until we can be shown some government which loves its subjects as a father loves a child."

If it be deemed the part of wisdom to, in the future, draw tighter the lines of governmental control, it should be done with great care, intelligence, and absolute impartiality to the end that the interests of the public, the reward of labor, and the rights of capital, shall receive equal consideration and protection, through a department to be specially entrusted with the performance of the delicate duties of such a position.

The power of control and regulation cannot be properly and intelligently exercised without detailed knowledge and a comprehensive understanding of existing conditions, which implies the right of inquiry and investigation, which should be promptly and cheerfully conceded. One of the greatest drawbacks to an intelligent consideration of our claims arises from the lack of confidence in representations made as to the cost of production and profits realized; the remedy for this lies only in the adoption of a system of public reports made in such form and by such authority that their accuracy and official character cannot be questioned. Not only will such reports correct false impressions, but will prove of great value for ready reference, as ascertained facts are immeasurably more reliable than theoretical conclusions. Compiled statistics are now the governing agencies of all industrial and commercial pursuits, they are the business world's unerring guide, giving to the unintelligent the assistance of intelligence, and thus the industry would as a whole gain advantages beyond the power of individual effort.

The ideal organization is one that will secure the best possible service at the least expense, and at the same time give a fair and reasonable profit, coupled with certainty of tenure and permanency of invested values.

This can, in my judgment, be accomplished through the appointment of a State commission to be organized and assigned duties substantially as follows:

FIRST: The State should provide for the appointment by its Governor, of a commission composed of three members; one a gas engineer, the second a skilled accountant, and the third a corporation lawyer, men eminent in their respective professions. They should be appointed for a term of ten years, removable only for cause; be required to give their entire time and attention to the duties of their office, and be paid a liberal salary to be collected pro rata from the gas industries of the State.

SECOND: They should be required to maintain an experimental station, laboratory and office, at the capital of the State, with a sufficient corps of clerks to compile and prepare for publication not only the statistical information required to be contributed by the various companies of the State, but also all general information in regard to the industry throughout the world, but especially of the United States.

THIRD: As an initial duty it should immediately require a full and complete statistical and financial report from each and every company in the State, and from such reports decide upon a fair and reasonable basis of capitalization.

On such basis allow a fair and reasonable manufacturer's profit, say 8 per cent. dividend, 2 per cent. depreciation, and 2 per cent. reserve to cover contingencies and risks; and on such basis fix and determine the price at which the company's product shall be sold.

FOURTH: With such price as a basis, further provide that any company which may afterwards reduce its price below the standard thus fixed shall be permitted to increase its divisible profits at the rate of 1 per cent. for each 10 cents reduction in price, and that thereafter all companies faithfully conforming to such requirements shall be guaranteed a perpetual franchise, immunity from competition and freedom from unwarranted municipal interference.

FIFTH: That said commission shall be required to serve not only as a bureau of information and advice, whether it be in the line of statistical information, engineering knowledge or legal advice; but shall also be required to promptly appear before councils, or in courts, for the purpose of defending and maintaining the rights and interests of companies unjustly attacked.

SIXTH: The commission should be empowered to visit without notice and thoroughly inspect and report upon the physical and financial condition of any company which through statistics furnished, or reports made by city officials, appears not to be maintaining the required standard of efficiency, or is failing to render the service required by the terms of its contracts.

SEVENTH: That in case any company after due notice and caution fails to maintain the required standard, comply with its contract obligations, or refuses to make the reports required by said commission, it shall be empowered to impose such fines and penalties as may be deemed proper, or upon the unanimous vote of said commission, approved by the mayor of any municipality in which it is located, have the legal power to revoke all the rights, franchises and privileges of such company.

The attempt to change the basis upon which gas undertakings have been founded to these herein proposed, should be carefully considered and intelligently made, so as not to do violence to invested values. No fixed or inflexible rules can be adopted as a basis for readjustment. Each corporation must, to some extent, be governed by an intelligent consideration of its own situation, so as to conform to the new conditions with the least possible friction.

So conditioned, regulated and controlled, gas companies would, in my judgment, be able to render greatly improved service at much less expense, and thus, through making friends of the public, enjoy a season of peace and prosperity to which the experiences of the past have made them strangers.

Discussion.

The President—Remarks are now in order on Gen. Hickenlooper's paper, and I will call upon Mr. Clark to open the discussion.

Mr. Clark—I consider that this paper is far and away the best article on this subject that I have had the pleasure of listening to or reading. Much that is good in it was not read by Gen. Hickenlooper. The first thing in it that occurs to me as calling for criticism is the phraseology of par. 6, page 2, which seems to put the burden of proof upon the opponents of the municipal ownership of gas industries. On page 16 Gen. Hickenlooper correctly defines the functions of municipal government as "Limited to the promotion of intelligence, care for the unfortunate, protection of life and property, and the establishment of equality of justice in all things." With that definition in mind, I think the paragraph I referred to on page 2 would more correctly express the true position, and possibly Gen. Hickenlooper's idea, if it read: "I believe in the establishment of regulated industrial monopolies for the performance of any public service that cannot be better performed through municipal agencies." Thereby putting the burden of proof upon the municipalities, if they desire to go outside of their legitimate field, and enter into the gas or any other industrial business. I have interested myself in this subject for a long while, and always found it difficult to formulate the definition which I find put to my entire satisfaction at the bottom of page 18: "If such an enterprise be operated with profit, that profit is the measure of the sum exacted beyond cost, and thus becomes a special tax upon the consumer for the benefit of the general public. If operated at a loss, the general public must make up the difference, and thus the non-user must pay a portion of the consumer's bills. If operated so that there will be neither profit nor loss, the public must pay the difference between the cost of a public and private rendition of service." While doubtless that definition came easily to Gen. Hickenlooper, I know of one man who has sweated over it many and many a day without being able to get it in a way that satisfied him as the definition of Gen. Hickenlooper apparently satisfies him. There is much more in this paper than the discussion of the relations between municipalities and gas companies. Were we to strike from it every paragraph in which gas is mentioned, there would still be left an argument that will prove a stumbling block in the way of industrial associations. I am sure the Western Gas Association is extremely gratified with the quotation on page 12 (which was not read by Gen. Hickenlooper) from one of Prof. Bemis's lectures. Prof. Bemis says, "Workmen are supposed to applaud when monopolies are denounced." I will read this because the General did not read it.

Gen. Hickenlooper—It would be well perhaps for me to say that in selecting from this paper what I should read, I did not omit that portion from any desire to omit it; but, knowing that the paper had been printed in advance of the meeting, and realizing that I might exhaust the patience of the members by an extended reading of it, I agreed with the Secretary as to the curtailment of the reading, believing that the paper would be discussed in its entirety, and not discussed from the portions which I read.

The Secretary—I wish to state that Gen. Hickenlooper was very much averse to trying the patience of the audience with a paper which would require over an hour of time in reading, and under those circumstances he was disposed to cut the paper. I objected to that, and he then said that if the paper was to be printed as prepared he would insist upon not reading all of it. I then marked the parts for him to read, stating that he was the proper person to make the selection of that which he thought it was right to read, but that I would comply with his instructions. So I made the selection, and he read those portions of the paper.

Mr. Clark—I will read the rest of this quotation from Prof. Bemis: "Workingmen are supposed to applaud whenever monoplies are denounced. It is much easier to clap one's hands than to set the brain to work to advance civilization, and such advance is inseparably connected with 'Monopoly.' In my days of ignorance I was taken with the idea that monoplies were the oppressors of the people, but the longer I live and the more I study people as well as theories, the more clearly I see that the wealth acquired by monopoly is the accummulation and the fitting reward of shrewdness and energy, and that the kicker at monopolies is simply kicking against the very means by which we have progressed out of barbarism." It certainly is extremely gratifying to know that Prof. Bemis has come to that position where he states that as his conclusion. I will say nothing more at present. Possibly after there has been some discussion I may ask to add something further.

Mr. T. D. Miller—This subject of municipal ownership is apparently agitating the whole country. I believe that much of the trouble has been occasioned by the methods of making reports, and in stating the cost of manufacturing gas particularly, in that the cost as stated very rarely ever included anything except simply the operating expenses and the necessary incidentals; whereas the other elements which enter into that cost are very rarely considered—such as wear and tear, depreciation, and the legitimate earning capacity of the capital invested. An expensive plant is maintained, and possibly the machinery has been put in such a way as to make the actual cost of the article in its production very much lower than it had been formerly with less modern and less efficient appliances; but just because the increased capital and the

improvement in the plant have made it possible to produce the gas at lower cost, to my mind constitutes no reason why that should be taken as a basis to show what the profits of the concern are when no consideration has been given to the capital invested. I believe it behooves all men managing plants where there is a large capital invested to arrive as nearly as possible at the depreciation (say to cover a term of years) and divide that up into a yearly charge, and so arrive at the cost of production by adding that in every year. I am satisfied that a great many people would be surprised (if they never have made the figures) to learn how little profit they are making, even when they think they are making a large profit. One feature of municipal ownership gets very little recognition from politicians and from the general public consideration of the subject. It is a well established fact that in all the newer portions of the country (and this whole country has at one time or other been a frontier) capital is very backward about investing in enterprises of magnitude; and, therefore, every growing community holds out inducements to get capital to come to them. The man who puts his money into industrial enterprises in new communities very often hazards his money. That he makes sometimes a good return out of it seems to me but logical and natural, and is something that any one should admit to be legitimate, but as soon as that enterprise becomes a prosperous one, every one says, "What a good thing he has. Wouldn't I like to have it." The very men who will kick the hardest against the enormous profits that they say are being made are the very men who would like best to have the big end of the horn of the investment. I think in some cases municipal ownership means practical confiscation. I recall to mind an instance at Austin, Texas, where a dam was built and an electric light plant put in by the city, which also established its own water works in opposition to a private corporation that was operating the water works, and the gas and electric light plants, and had invested there over $1,500,000. The thing was made a special political issue. I recently saw a circular sent out by the Mayor of the city (I regret I have not got it here to read) which is not only a most astonishing document, but one that any man should be ashamed of. It stated that the citizens should patronize their own enterprises; that if they did not do so they would have to pay taxes enough to support the enterprises; that they would have to pay the private corporation a profit on that which they bought of them and then pay the taxes and help bear the expenses of their own enterprises. Now, here were companies that came to Austin to invest their capital, and by their enterprise helped to make the city what it is; but now they are to be taxed to help pay for another institution which comes in and ruins their investment and practically confiscates their property. I recently made some figures, based upon municipal ownership, as to the municipal plants there were in the Southwest, and in our territory; and found that the reported cost of operating and maintaining (in every case it was an electric light plant), only considered the operating expenses, which were about 60 per cent. of the real cost, figuring the cost of the investment at the interest rate that the bonds issued to pay for it were bearing, and figuring the depreciation at 10 per cent. per year only on the electric light plant. I say, figuring in that way, the cost reported was only 60 per cent. of the total cost. The politicians and the newspapers in advocating municipal ownership used those figures—the cost of operating only; no consideration was given to other expenses. It is not at all surprising, therefore, that people who read the newspapers and listen to what the politicians have to say are led into the belief that municipal ownership would be a good thing. I think the best and shrewdest way of stopping this craze, which seems to be going over the country, for the municipal ownership of electric light plants particularly, is the education of the public; and I do not believe that much can be accomplished through an attempt at legislation, for as soon as a private corporation, or a body or association composed of the heads of private corporations, takes any action looking towards legislation, it is regarded by the public at large in much the same way that a bull regards a red flag. I believe the recent move made in the Texas Association, to try to have some influence upon legislation, to be an unwise one. I believe that in that body, or in any similar body, it would be a very dangerous thing for the private corporations interested in the State where the attempt was made.

Mr. Kahn—I rise with some hesitancy to speak on this subject, as I have only just joined your Association as an Associate member. I am connected with the National Association of Stove Manufacturers, and, through my connection with that Association, I have had ample time and opportunity to learn a great many things which seem to me to have a direct bearing upon the important matter before the Association at this time. And as I never like to be the fifth wheel of the wagon, I would like to help do some little work, when there is any work to be done. That is my only apology for putting my oar into your discussion at this time. General Hickenlooper does things so well and so thoroughly that it would be manifestly unjust and unfair, even though one might pick out here and there some trifling flaw, to say aught against the many magnificent suggestions embodied in his paper; but if the gentleman will permit me I would suggest that he evidently ignores, in his treatment of that topic, one of the most important and most potent facts that you, gentlemen, have to consider and deal with; and it is a fact which interests stove manufacturers just as much as it does street car men, or as it does school desk men, or as it interests the representatives of any and every industrial interest within the boundaries of the United States. This question of municipal ownership is simply one phase and one expression of a national misfortune. It is simply one phase and expression of popular perversities. It is simply one phase and expression of a prejudice which has been nursed by false political economy and by false political and social principles. Why, gentlemen, you come together here to discuss matters that relate solely to the gas industry. I want to say to you there is not an industrial interest within the limits of the United States that has not suffered as much, and I dare say, judging from what little knowledge I have of the basis of the dividends you pay, a great deal more, than this industry suffers, by reason of this perversity, by reason of this fearful mistake that has crept into the courts, into the legislatures, and into the municipal councils of this great country, by reason of the ignorance and error that seem to pervade this whole people in relation to its proper sphere, and to the rights, and to all those things that will best develop the interests of our people and of our whole country. My connection with the stove business led me recently to make an estimate of what had taken place in that industry, and I ascertained that within the last three years more than 97 stove manufacturers had been driven to the wall. I also ascertained that within the last ten years more than a million and a half of capital had been sunk in the stove business. Gentlemen, do you know what has done it? Nothing in the world but the cannibalism of competition—this theory of our courts and of our legislatures that, in order that this country may live and that its people may thrive, they have to get a bulldog to run after the fellow who is trying to make a living, and bite him in the leg, and pull him down. In other words, that they must have competition, and that without competition they cannot exist. Their idea is that without competition there can be no justice to the public. Col. Warrie, of Hamilton, Ohio, a few days ago, in discussing the matter with me, said, "Mr. Kahn, is it not true that competition is the life of trade?" I said, "Yes, it is true; but it is also the death of profits." The sooner that fact is recognized by the gentlemen of the Western Gas Association, by the gentlemen who belong to the National Stove Association, by the gentlemen who represent the Tanners' Association, by the gentlemen who make stockings, and by those who make pins, and matches, and everything else, the sooner they will get together—because one single industry working by itself is not able to accomplish very much—and the sooner they all get together and assert the rights of these great industrial forces of this country, the sooner will those rights be recognized. We are all to-day the victims of legislative ignorance and prejudice. That is all there is to it. We send to the legislature and we put upon the bench men who have been skilled in the law; but they know nothing about business. If we could have more business men in our legislatures, and if we had the means of conveying to these legislative bodies a knowledge of the fact that these people who are engaged in developing the industrial enterprises of the United States are eating one another's heads off, the sooner we would be free from these everlasting complications and disturbances which seek to prevent the honest man who tries to put a dollar into corporate property from taking it back again, or from protecting it as it should be protected. This is the time when these co-operative measures are absolutely indispensable and necessary. And if you stop to think, the best thing you gentlemen can do is to appoint a committee, and have that committee solicit co-operation from other bodies who are situated similarly as you are, and who by reason of legislative preventive measures are unable to help themselves and to keep the wolf from the door, you will in that case and in that way accomplish far more and do it in a better way than you can by going to the legislature and simply claiming rights for yourselves, and ignoring similar rights that are just as badly needed, just as badly wanted, and that other parties would work just as hard to get as you can possibly do yourselves.

The President—Are there any other remarks to be made by members before General Hickenlooper replies? I will say that the time is rolling on rapidly, our hours are limited, and we have a great deal of business ahead of us, and while I do not want to choke off discussion, I hope that gentlemen will be brief in order to give as many as wish an opportunity to speak. General Hickenlooper will take the floor for a minute or two.

Gen. Hickenlooper—I wish to say one word further, rather by way of voicing my advice than anything else; and what I have to say is called for by Mr. T. D. Miller, whose personal acquaintance I have not had the pleasure of making. It has reference to the position which unfortunately the gas men of this country have too frequently taken; namely, an excessive modesty, or an indisposition to themselves actively interfere with the shaping of legislation. You have first to appreciate your own strength. You must recognize the fact that probably no other industry in the country is controlled or directed by a more intelligent body of men than is the gas industry. There are few if any industries in the country whose representatives have a wider and more general scope of acquaintanceship than have those of the gas industry. It is not alone your privilege, but it is your duty to step actively and aggressively to the front in the shaping of legislation. It is a false notion, a false theory, that so little confidence is placed in the integrity of gas men that they must forever be skulking in the shadows and keep away from the light of day. (Applause). There never was a more forcible illustration of this fact than what has recently taken place in the Legislature of the State of Ohio, where a bill was introduced which proposed to place such a burden of special taxation upon the gas industries of the State as would absolutely have ruined that industry. As applied to the Company I represent it

would have compelled the reduction of our dividends from 10 to 6 per cent., and a reduction in the market value of our stock from 203 to 122—or the absolute destruction of seven millions of dollars of invested values. And it applies with equal force to all the gas industries of the State. They came under the active leadership of the President of the Ohio Gas Light Association, who displayed unusual activity, not only under the rose bush, but openly and avowedly, for the purpose of protecting that industry. The result was that the representatives of that interest were received with every consideration that could be given; the committees were thrown open to every one who desired to appear before them; and, through intelligent direction and wisdom, the claims of the gas companies were acknowledged in toto, and legislation was so modified that the companies with one accord said they would gladly accept and pay the tax which, under the modified terms of the bill, was imposed.

On motion of Mr. Clark a vote of thanks was tendered to Gen. Hickenlooper.

The President—We will now listen to the paper by Mr. M. S. Greenough, of Cleveland, Ohio, entitled,

THE FUTURE OF THE GAS BUSINESS OF AMERICA.

If it is necessary for the proper composition of a paper that its author should have definite and unchangeable views upon the subject of which he is writing, then I am not fitted at the present time to do this subject justice. I admit at once that I may be wrong in the position which I shall take. If I am proved, hereafter, to have been so I shall express no regret, but only call your attention to the fact that it is easier to narrate past events than to prophesy about future ones.

The subject of which I speak, The Future of the Gas Business in America, naturally divides itself into three heads:

First—Is the business itself to prosper?

Second—What sort of gas is to be made?

Third—Who are going to make it?

In considering the first question I am, fortunately, assisted by statistics. Among the other useful purposes for which the Gas Commission of Massachusetts exists is that of supplying, with gratifying accuracy, facts relating to the gas and electric companies of that State, and I have spent considerable time in analyzing various figures extracted from their reports.

From the report of 1890, the first issued after the electric lighting companies had been put under their supervision, I took the returns of ten of the most thickly settled cities in the State, including Boston. I then made a summary of the gas sold during the year ending June, 1889, and the number of electric lights installed at that time in the same localities. The gas sold by these ten companies amounted to 2,131,059,000 feet and the average of the ten prices charged was $1.62. In the same cities there were 2,296 arc lamps and 34,560 incandescent. Six years afterward these companies sold 2,599,631,000 feet at an average price of $1.195, an increase in output of 21 per cent.

As, however, by far the larger part of this gas had become water gas a fair comparison of gains ought to allow something for the difference in specific gravity, and if 10 per cent. were added for this, which I think not unfair, the output would have been 2,858,631,000 feet, or an increase of 34 per cent. in six years. This is not the increase that used to obtain when a company generally doubled its output every ten years, but on the other hand, whichever set of figures are taken, it is a very healthy increase. Now we also find that during the same time the arc lamps had increased in number to 3,960, or 71 per cent., and the incandescents to 208,200, or 502 per cent. These figures showed conclusively that more light is used and that there is room in the community for both kinds of it. I think it might also be asserted that such a growth of electricity could not possibly be duplicated and that its increase hereafter would be much more gradual. It is, however, worth investigating, whether this increase of gas consumption has been obtained by hunting for new business in the suburbs of these cities on account of electric light competition in the centres and by laying mains to people who would not, in the ordinary course of business, have been considered paying customers.

I find in this report that the sales per mile of mains laid in 1889 were not so large as those of 1895, providing proper allowance was made for duplication of mains and change of gas. It seems to me proved, therefore, that electricity is not seriously hampering the development of the gas business in Massachusetts, and it must be remembered not only that the price of gas in that section of the country is higher than in many places further west, on account of the distance of that State from both the coal and the oil fields, but also it is to be noted that there is probably no section in this country, outside of New York City, in which there is so large a proportion of the population who can afford to pay for a luxury which they fancy, as there exists in the prosperous cities of Massachusetts. By far the greater number of dwellers in this country want the cheapest light by which they can see to do their business or with which they can comfortably light their houses, and I cannot but feel that if gas were sold in Massachusetts to-day at the price which is obtained in Ohio these records of output would be very different. I am largely influenced in this opinion by a comparison of sales of the Cleveland Company in 1889 with those of 1895. In spite of the fact that the growth of that city has necessitated our laying many miles of pipe into the suburban districts and that our gas is not so high in candle power as in some of the Massachusetts cities, yet our increase has greatly exceeded theirs in percentage and our sales per mile of main are also higher than in 1889. The conclusion which I draw from this is that a gas of moderate candle power sold cheap is a better competitor for electricity than gas which is higher both in candle power and price. I mean to say by this that in my judgment the necessity for high candle power gas to compete with electricity no longer exists, if it ever did. Let us face the question fairly and admit that for many purposes gas cannot compete with electricity at any price or of any quality. Many people like the cleanliness, convenience and lack of heat which they get from electricity and they are determined to have it at any reasonable figure. We may as well make up our minds that most of the theaters, hotels, office buildings, clubs and many of the larger stores are not going to be lit by gas again, and turn our attention to catering to a different need. Most prosperous people use gas in their houses to light their halls and bedrooms and give a general illumination to their rooms while they prefer oil lamps for reading purposes. They will also use gas freely where it is cheap for heating and cooking. In some of the good resident districts of Cleveland it was found by examination on the part of our meter takers that two-thirds of the houses were fitted with gas ranges for summer use, and this use is constantly extending, not only in dwelling houses but into many kinds of manufactures. If a man wants a bright light he can get it from a Welsbach burner either in his store or in his house, but most people don't want a bright light, they want a pleasant, moderate light of a slightly yellowish tinge. For all manufacturing purposes, for cooking and heating, they want a gas of as many heat units as possible and one that does not smoke. I have gradually been driven to the conclusion that an unenriched pure coal gas of sixteen to seventeen candles would give more general satisfaction to a community than any other material which could be supplied. We get ten complaints in our office of the gas smoking for one of lack of light. Electricity is the bright and ornamental light par excellence, and gas, in my opinion, would meet better the demands of the public for light, heat and power, if its other qualities were not wholly subordinate to illumination. I believe that the community at large would get more satisfaction out of a 16 candle coal gas than they do out of a 19 candle coal gas or a 25 candle water gas, especially if they could get it any cheaper. I am not prepared, however, to endorse the use of gas from a coke oven. I question if it is over 10 candles and I doubt if it can be made good enough without also making it smoky, but 16 candles seems to be a standard and satisfactory light all over the world and can be made from our American coals. It is possible that the coke oven gases are going to play an important part in our manufacture, but I have my doubts about it, and they rather increase than diminish. One thing is, however, clear that their general introduction into iron works will soon reduce the value of the residual products from coal gas, and in that case the cheapness of manufacture which gas from coal now enjoys throughout a large section of country may disappear and water gas become the cheaper. If this proves to be the case then it may be water gas that should be supplied. The gas which can be sold at the lowest price and at the same time contain the elements both of illumination and of heat is the gas to be furnished. It is not likely, however, The price of oil has certainly risen and is likely to go higher. The extinction of most of the natural gas wells seems only a question of time and when they go out they will greatly help coal gas by affording a better sale for coke throughout the Western States. My prediction is that the tide is on the turn and that in five years from now the percentage of coal gas made in this country will be much larger than it is to-day.

As to the future management of this business I admit that I am in doubt. My opinions vary according to my state of mind. On

days when I am hopeful for the future of this country and believe that it will gradually work out of jobbery and corruption into an honest and civilized method of transacting city and State affairs, then I think there will be at the same time some peace in the management of municipal corporations, and that the gas companies will be allowed to make a reasonable profit, under a strict but not improper supervision, without fear of confiscation or blackmail, but at other times it seems as if the country was going gradually from bad to worse in the administration of its great cities, and that there was little hope for better things to come. On the whole I am inclined to take a hopeful view.

There are four ways of managing a gas company. First, there is the familiar way of fighting for all that can be got and hanging on to it as long as possible, with every man's hand against the gas company, and as there has been in most States no protection against organized blackmail or raid, it has seemed to many companies that the only thing to do was to make as much money as possible while they could. So far as I have observed this generally led eventually to competition and usually to purchase by outsiders.

Second, is the manufacture of gas under protection of the State, such as is given in Massachusetts, and such as is accorded to some extent in Ohio.

Third, is the manufacture under control from a central point by which the ownership passes to capitalists in some distant city who have faith in gas either as an investment or a speculation, and who hope to effect economies by consolidation of officers, etc.

Fourth, is municipal ownership. This is, in the minds of many people, a panacea for all their troubles. If they are dissatisfied with the management of their gas works or their street railways they demand that the city shall take them in hand and run them for the municipal benefit. The success of this plan in some foreign municipalities is pointed to as an indication of what can be done here, but this claim cannot be allowed to pass unchallenged. What is it that a city wants in its supply of gas? It wants the gas furnished of good quality, which shall be frequently tested for candle power and for impurities by somebody in whom the public has confidence. It wants the gas supplied at such pressure as shall enable any consumer in the city to get all he wants even on the end of the most distant connection with the gas works and yet not to have the consumer nearest to the source of supply subjected to a pressure too high for economy. It demands civility and respectability on the part of the employees. They must go into every house in the city and at such times as they choose. They must be sober and reliable men. It demands that the gas shall be furnished at such a price as shall yield a fair return on the investment, including the risk, but shall no longer give such profits as in the early days of the development of the business. Now we know, as observers of facts, that while such a thing is feasible in some of the great cities of the old world, in this country it is distinctly not. I am in some doubt as to how long it is going to take the American people to find it out. It is not difficult to discover the reason why we cannot do things as well in our municipalities as they can in England or Scotland. Universal suffrage and rotation in office are at the bottom of it. I do not mean to put myself across the path of that cardinal principle of American politics, universal suffrage. It may have been on the whole a good thing for the country in inducing immigration in the days when we wanted it and before we were considering how to stop it, but it certainly does not tend to fill our city councils with that class of men whom we would naturally elect to manage our private affairs for us. When only the taxpayers and rent payers of a large city vote for municipal officers and the alderman when chosen is chosen for life, it is not impossible to get the best citizens in a community to accept such a position and to supervise municipal work in such a way as to insure its freedom from corruption or even political jobbery. There was never a time in the history of this country when there could be found more men of intelligence and patriotism who are willing to work for their cities or States than the present, and the whole question of municipal management and taxation is undergoing a most thorough overhauling. I cannot but believe that the business intelligence of this country will finally get the upper hand, and that national politics and municipal business will be absolutely divorced. It will be a long day first, however. Meanwhile, if any person wants to prophesy about the working of this scheme in this country he has only to look at the results of some of the cities who have already tried it and see what has happened. The larger the city the worse the case. Yet the people as a whole seem to be indifferent so far, and no amount of testimony of mismanagement seems to rouse them sufficiently to make them do anything effectual. The supposed exigencies of national politics seem to bar the way to reform. No reasonable and honest man, however, who examines the results of municipal management, as exemplified in this country, can want anything to do with it. He has also seen the utter failure of competition to reduce the price of gas permanently and he is gradually turning to regulation as the last alternative. What does he find? He finds that in Massachusetts, which has often set the example for other States to follow, that the principle has been substantially adopted for ten years back, of regulation by a state commission in both price and quality and protection given against competition. It is true that the present condition in Boston hardly carries out this statement, but the circumstances there were unique. It will be found as a whole that under this plan the price of gas has steadily decreased while the quality has improved, and the stocks of the well managed gas companies have at the same time increased in value on account of the security of the investment. The only thing which the people of Massachusetts complain of is that they cannot make the corporations occupying their streets pay them something for their privilege. Now in Ohio the municipalities have the right to regulate the price of gas from time to time, and to make a bargain on reasonable terms with a gas company for a time not exceeding ten years, and in doing so can of course insert such conditions as they desire and can get the companies to agree to. I think this arrangement is more advantageous to the public than the Massachusetts plan.

It would in many ways be to the great advantage of the gas corporations of any State to have an honest tribunal to which they could appeal as against the hasty or corrupt action of a municipality, but I do not really think that popular sentiment through the country is tending towards commissions. It is distinctly tending, however, towards making such bargains with the corporations enjoying special privileges in the streets as shall make them contribute something more than their ordinary taxes towards the expenses of the government. Personally, I think this a good thing for both parties. I am aware of the fact that this sentiment is by no means universal among the corporations, on the contrary, I was a little surprised to have it characterized as immoral, in Philadelphia, at the meeting there in October of the American Gas Light Association. Let us look at this thing a little. It is substantially to be argued on the same basis as the question relating to the price at which gas shall be sold by municipalities. Are they or not justified in taking extra profit out of the consumer and making him pay money for the benefit of the taxpayer? In other words has the taxpayer any equitable rights in the streets? The matter has been fought over in the newspapers of Cleveland this winter as relating to the rates of street railroad companies, it being contended by some that the true method was to make the fares as low as possible, and let the person who rides on the cars get the whole benefit of economy, giving nothing to the person who rides in a carriage or drives a team for the inconvenience to which he may be subjected by the use of the street in front of his door and over which he drives, by the swift and dangerous electric cars. I fail myself to see that this is just. It is distinctly an appeal to the poor man as against the wealthy. I admit that the case against the street railways is the strongest that can be taken, but the same thing holds good in gas or any other public service. The taxpayer has some municipal rights as such, whether he uses gas, electricity or oil for lighting, whether he puts in a telephone or not and whether he rides in the street cars. In my opinion he is justified in demanding some consideration for himself on account of the use of the streets. His industry and activity in business are giving life to the city and making valuable the franchises enjoyed by corporations; his brains are making his city grow and are affording opportunities to the gas and other companies to greatly increase their profits without a corresponding increase of investment.

To appeal to public opinion is not a decisive answer, but the trend of public sentiment is certainly in that direction and, in my opinion, there will, in ten years from now, be very few large cities which are not getting some help for their treasuries from this source. In my judgment it is wise and fair, and it will, I think, be found in most cases to be a satisfactory solution of the question. The city gets a profit without investing any money, which is much better than taking the working of the business themselves. I do not think it is according to the genius of the American people to encumber

the municipalities with any other duties than governing and furnishing water, and I say without any hesitation, after very considerable experience in water works, that there is hardly a city on this continent which would tolerate for a moment from a private corporation such a supply of water as they furnish to their citizens themselves. Besides that, it has the distinct effect of dampening any zeal for economies or improvements. There are some brilliant exceptions to the rule, but in general the steps in advance have been taken by the managers of private enterprises. Any man can see why this would naturally be so without my dwelling further on the subject. I venture then to express my opinion that the gas business is in no danger of being disturbed by electricity, if gas is sold reasonably cheap; that there is sure to be a great development of the business where gas is sold at 80 cents or lower; that a gas of moderate candle power, but rich in heat units, such as can be made from good Pittsburg coal, is going to steadily increase in popularity and use, and that most of the large cities will eventually terminate their disputes with their municipal governments by paying them a percentage of their receipts.

Discussion.

The President—Mr. Greenough's paper is now before you for discussion.

Mr. Humphreys—I shall not attempt to discuss Mr. Greenough's paper from end to end, for it covers a very large field; but I would like to refer to one or two points. With much that Mr. Greenough says I can thoroughly agree, but with a few of his points I have a disposition to disagree. I notice he refers to, or rather makes, a comparison between the prices existing to-day in Cleveland and in Massachusetts. To have the thing brought out clearly, we ought to know how he obtained $1.62 as the average price of 10 Massachusetts Companies. Is that an average of the 10 prices, or is it an average based upon total sales? As it looks here, of course it is twice the price of the Cleveland Company. I presume this is not correct, Mr. Greenough?

Mr. Greenough—Those first 10 prices?

Mr. Humphreys—Yes.

Mr. Greenough—They were simply taken for the 10 Companies, and are the average price of the whole.

Mr. Humphreys—That would not be the correct average price of those Companies for the amount of gas sold in that locality; and, therefore, is a little unjust as a comparison for them. With regard to the question of specific gravity affecting sales, I think that that is more a question of illuminating power. The introduction of water gas brought about a different condition through its increase in candle power, rather than through its increase in specific gravity. People would get less gas through the same fittings on account of increased specific gravity, but of course they would correct that promptly and would go for the same amount of light. I think that, as a rule, it will be found that there has been an increase in the quantity of light demanded, rather than a decrease. I do not know that we are quite safe in drawing our conclusions from the statements at the bottom of the second page, that the cities of Massachusetts are prosperous, and are, therefore, able to do much better by the gas companies in the way of purchasing gas than some other cities can do. Some of our cities in the West may not perhaps be *able* to buy so freely, but they certainly do, if we come right down to the per capita; and in fact I think they are more extravagant.

Mr. Greenough—I thought I had made it clear that they expended more there because they are really more thrifty and not because they could afford to spend more money, if really thrifty.

Mr. Humphreys—Then I am mistaken. On page 3 Mr. Greenough says: "The conclusion which I draw from this is that a gas of moderate candle power, sold cheap, is a better competitor for electricity than gas which is higher both in candle power and price." To my mind it seems clear that the strong tendency of late years to higher candle power gas has had much to do with the increase in gas sales in the face of strong electric light competition. As far as the illuminating business is concerned, in comparing gases which will give satisfactory results to the consumer in practice, we must consider what is the cost per unit of light. As far as smoke is concerned, it is now generally acknowledged that if we use water gas as our enricher, we can go to much higher candle powers and still experience no more, and even less, trouble from smoke than from the unenriched gas. Bearing this in mind, we find a 26½ candle power gas at $1.25 is as cheap to the consumers as is a 17 candle power gas at 80 cents—*for light*. But we also know that, as a rule, a mixed coal and water gas, raised, say, from 17 to 26½ candle power, will not cost as much per candle as will the 17 candle power gas. The increase in cost is not, as a rule, nearly in proportion, to the increase in candle power; and this even at prevailing prices for oil. The increase in candle power in the case cited is 50 per cent. It would be hard to find a case where the increase in cost is in this proportion. In fact, in many cases the increase in candle power (if all factors are considered) can be obtained free of cost, and, in the majority of cases, the increase in candle power can be obtained at an increase in cost much less in proportion than the increase in candle power. With Mr. Greenough I am in doubt as to how the gas business is to develop, what kind of gas will in the future be sold, etc.; and I am in doubt how the coke oven business will affect it. To my mind this is certainly more of a coke question than a gas question at present, but I do not think we want to blind ourselves to the gas possibilities. Probably the oven gas will be 10 to 12 candle power, possibly not more than 10 in practice; but I do not see any reason why it cannot advantageously and economically be brought up to any desired candle power. In manufacturing water gas hot coke would be here available. Water gas can be made very cheaply in connection with such a plant. So I think this coke-oven process is something we want to bear in mind in connection with our looking into the future.

Mr. T. D. Miller—I would like to ask Mr. Humphreys if he has reference to any particular locality when he says that an increase in cost would not be in proportion to increase in candle power on account of the use of water gas; and if he had in his mind any cost of oil on which he based the statement of the relative cost of oil and coal gas?

Mr. Humphreys—I do not think I quite understand your question.

Mr. T. D. Miller—You referred to the increased candle power of water gas, and said that the increase of cost was not anything like, or in direct ratio, to the increase of candle power. I want to know if you had reference to any particular locality in speaking of the relative cost of oil and coal when you made that statement.

Mr. Humphreys—That is a question I would not want to discuss in any great detail here; but I will say that my estimate is based upon calculations made in a great many localities by an actual reference to the cost of all materials.

Mr. T. D. Miller—Had you any particular locality in mind?

Mr. Humphreys—I would be glad to take up any particular locality that the gentleman has in mind. It might go one way, or it might go the other.

Mr. T. D. Miller—What I mean is whether you made the comparison of cost in Ohio in the oil fields, or in Pennsylvania in the coal fields; or was it in Montana?

Mr. Humphreys—I will say that it can be shown very clearly in most cases to include rather high priced oil, and not very high priced coal.

Gen. Hickenlooper—I desire to say that I most heartily approve of the paper read by Mr. Greenough in almost all itsvaried references, excepting I believe with him that the gas of the future is the 17 candle power gas; and that the question of price is a very much more important factor in the public mind to-day than is the question of candle power. I believe that the more nearly you approximate to furnishing a gas adapted for all domestic purposes—through the same pipe, through the same meter, charged for in the same bill—will be found in the end to be decidedly the most satisfactory character of service. I do not believe in his assertion of the justness of a special tax being imposed upon the gas companies for the benefit of the general public. It would be rather cruel in me to refer to the inspiring motive of his assertion of the justness of that tax, by relating the familiar story of the dog that lost his tail, and thereupon desired that every other dog should submit his tail to amputation. (Laughter). I do not think he will take the position that a gas company must pay tribute to the contributory intelligence of every citizen who walks the streets, because that contributory intelligence aids or benefits the gas companies. He says: "In my opinion, he is justified in demanding some consideration for himself on account of the use of the streets. His industry and activity in business are giving life to the city and making valuable the franchises enjoyed by corporations; his brains are making his city grow, and are affording opportunities to the gas and other companies to greatly increase their profits without a corresponding increase of investment." I object very seriously to that sentence. If it were true, then we would find our pay rolls so vastly increased that it would be impossible in my judgment to derive profit from the industry. In other words, if we are to concede something to every citizen for the advantage which he gives to our business by his intelligence, we would be placing ourselves in a very embarrassing position. I do not think that the general public are worthy of serious consideration in this connection.

Capt. White—Mr. Greenough has voiced in the paper just read to us a sentiment which I have very long held, and which, in a recent argument before the United States Senate Committee of the District of Columbia, I put in as decided and definite language as Mr. Greenough used here to-day; and that is that I am a thorough believer in the fact that the gas made by the gas companies of this country should not exceed more than 16 or 17 candles in illuminating power; that it should be a coal gas for the purposes of distribution as fuel, as well as for use as an illuminating gas; and that there should be the same system of meters, of mains and of pipes for both purposes. I have long felt that every dollar that was spent in making this high candle power gas was a distinct robbery of the stockholders of the company, and of no earthly benefit to the consumer. Think for a moment and you will be convinced that in every 100 consumers you have there are probably not two whose burners are of a character that enables them to enjoy the high illuminating efficiency which you give your gas. You are simply taxing your corporation for a purpose which is of no earthly use to the man who buys your material. I have long felt that the future development of our business will be in the line of the manufacture of a low grade of coal gas which will furnish both light and heat, and which can be sold to the consumer cheaply. I heartily endorse from my own experience the remarks of General Hickenlooper, who is certainly the best exponent here among us of his own views,

for he has been making a life-time fight for coal gas of about that candle power. I heartily believe that more money will be made in the future by the manufacture of this character of gas, and that the public will take it simply because it is cheap, and that they will use it in all their various manufactures, as well as in lighting their houses and for cooking; and that from the increased output we will make more money. You will find, as I said a moment ago, that our future development will be in this line; and that undoubtedly the changes in our machinery which are yet to come will be in the direction of making large quantities of coal gas by means of very compact machinery, on somewhat the same principle that water gas is now made; and that if any special set of individuals want gas of higher illuminating power it will be obtained through some form of incandescent burner, the line of which is indicated to us by the Welsbach—that may not necessarily be the lamp of the future, but developments will be on that line; and the consumer will be furnished with some cheap, efficient and durable method of increasing candle power by the use of incandescent burners. I also want to take exception in one respect with Gen. Hickenlooper, by making the statement that I do most thoroughly believe that gas companies, water companies, and all people exercising the municipal rights belonging to a city, and which the city has merely delegated and placed in our hands for operation, should permit the city to participate in some of the profits accruing. They give to the companies most valuable franchises for nothing, and, gentlemen, if you will think for a moment, what a benefit it would be to the various municipalities which you represent to have some slight part of the gross income of every corporation doing business in that city placed in the city's treasury; if you will think how much better we would all be, how much less our taxes would be, and how much more freely business could be done, I am sure you will agree with me in this statement. I thoroughly believe in the principle that the city and the State have the right not only to levy taxes upon our actual visible property, but also upon the right which permits us to do business in the streets.

Gen. Hickenlooper—I would like to ask the gentleman if the tax is imposed and is paid by a gas company, from what source the ability comes to pay it; and whence the money with which to pay that compensating tax to the city?

Capt. White—It will come out of the people.

Gen. Hickenlooper—It comes out of the consumers; does it not!

Capt. White—Exactly.

Gen. Hickenlooper—It comes out of the men who pay for the gas used?

Capt. White—Certainly, it does.

Gen. Hickenlooper—Therefore, it might become a special tax upon the gas consumer for the benefit of the general public?

Mr. Greenough—Certainly.

Capt. White—Yes.

Gen. Hickenlooper—Is that just?

Mr. Greenough—You can answer that yourself.

Mr. Clark—It may be that the day of low candle power gas will come, but I do not expect it until the development of the incandescent lamp. But if it is true, then I think that Mr. Greenough makes a very poor argument in his effort to prove it. Mr. Greenough's experience with low candle power gas has brought him to the conclusion that he must give up supplying theaters, clubs, hotels and office buildings with gas; but my experience with higher candle power gas has brought me to the conclusion that we can get back from the electric light people most of the consumers who left us in the past because they wanted electricity, and most of the consumers who sought after novelty. I had great pleasure in Mr. Greenough's statement about payment to the city for the use of the streets. I am unable to see any force in what has been said against it. Naturally, it is paid to the city from the receipts which the gas company gets from the consumers. If streets are opened occasionally for the convenience of the gas consumers is it not proper that they should pay to the citizens, for the inconvenience they suffer by reason of the opening of the streets, something in compensation for that inconvenience. It would seem so to me. I regret very much to find that gas men in the West (and particularly Mr. Greenough), are in such poor spirits as to be willing to give up the illuminating business in their towns. I do not want to be considered as speaking to the galleries, but that was not the spirit which animated Hooker's army out here on the point when they stayed the advancing army on the other side of the Ridge. We have a right to the illuminating business of the city because we have the best illuminant for a city. I thoroughly agree with Mr. Greenough that there are locations in cities, and that there are uses for which the incandescent electric light is better adapted than gas light; but for the general illumination, and more especially for illuminating such places as he refers to here, I believe gas is best adapted, and that gas is going to have the business. The foundation of my belief is what I have seen in the cities in which I have had more or less of interest, and where to my knowledge in just such places (barring theatres) gas is now displacing electricity.

Mr. Humphreys—In regard to this question of higher or lower candle power gas, I would like to add that if the net result to the consumer and to the company, by the use of low candle power gas, is greater than by the use of high candle power gas, then the lower candle power gas is the best; but if we can produce a gas which can be distributed through the same set of mains for all purposes, at a cost not to exceed the average cost to the consumer of the lower priced and lower candle power gas, then the high candle power gas must be an advantage to all. I thoroughly believe in giving to our consumers the advantage of the lowest possible price compatible with geographical positions.

Mr. Jenkins—I would like to have a word here on the question of taxing gas companies. My friend states that if the consumer, for his own purposes, has to have the streets torn up, he ought to pay something to the other taxpayers for that privilege. If that is a fact, then why should not every coal dealer, expressman, laundry wagon, in fact, everybody else who tears the streets to pieces ten times more than the gas company does, do the same thing and pay their proportion of their gas receipts.

A Member—They do.

Mr. Jenkins—In what way?

A Member—By paying for a license.

Mr. Jenkins—They do not pay one-tenth of one per cent. of their gross receipts for that license. If you would make every one who uses the streets pay for that use in the same proportion that a gas company does, then there would be some fairness in the suggestion; but to make the gas companies assume all these debts is neither fair nor just.

Mr. McIlhenny—One thing I would suggest after the thoughts we have heard expressed in the last half hour, and that is the very excellent feature adopted by the Ohio Gas Light Association at its meeting last month. Certain papers were discussed in executive session. It seems to me that the subject that has just been discussed, and many of the arguments which have been presented, could be more appropriately considered in executive session. While we like to discuss certain subjects relating to the progress and prosperity of the gas business and its prospects for the future, still to have arguments published which may be brought up to worry us at another time may not be desirable. The opponents and socialistic elements to-day are very thoughtful and wise, and they watch carefully and read everything that is said; and it seems to me that some of the arguments presented here to-day could be used against us with very great force at some future time. I would suggest for the consideration of the meeting whether it might not be desirable to request the Secretary to use his discretion in withholding from publication certain of the speeches presented. One conclusion that may be drawn from what has been said on the subject of gas at our meeting to-day, is that while it has been discussed in several lights, there has been no uncertain tone presented as to the future stability of the business; and it seems to me that everything that has been said has added to the belief that we ourselves entertain the belief that the gas business is on a most solid footing, and that the developments of to-day are placing it on a more solid footing than ever before; that while possibly in the time to come there may be a change in the avenue of sales of gas, yet new developments are opening fields which are even larger than any we have now, and it seems to me the gas business has more to look forward to to-day than it has had at any time in the past.

Mr. McDonald—I think Mr. Jenkins makes a mistake in his premise that the gas company is to pay it all. I do not think any of the speakers intended that view of the case. I might illustrate by referring to something outside of the gas business. I live in a section of the city that is situated between the suburbs and the center. A railroad corporation came along and wanted a franchise to lay their tracks through the street I live in for the benefit of people who do business down town, but who live in the suburbs. They get their franchise and lay down their tracks. What do they do to me? They reduce the value of my property the moment they place the tracks. For whose benefit do they do it? For the benefit of the people who do business in the town, but who live in the suburbs. Should not those people pay something to compensate me for the damage the railroad company has done to my property. So I assure you I am very strongly in favor of compelling that corporation to pay something towards general expenses.

Mr. Jenkins—That is not at all a parallel case. There they occupy the surface of the street, and take about one-fifth of that surface. They run their cars up and down that street, and do damage to that property; but I fail to see wherein a gas company by going into a street damages any man's property. On the contrary, the value of property is largely enhanced when gas pipes are laid in a street. While the pipes are being laid the street is disturbed, but the gas company is required, at considerable expense, to put it back in as nearly as possible the same condition as before the pipes were laid. Who pays that expense? That is in addition to the tax or percentage paid on your gross receipts.

Capt. White—In a word or two of reply to Mr. McIlhenny's remarks I would say I think most of the gentlemen present will agree with me in saying that one of the most serious mistakes made by the men who controlled gas companies in the early days, was this idea of secrecy. That practice led the public to believe that gas makers were pursuing a kind of business which had enough of marvel and mysticism about it to be shut up in dark closets and kept from the public. The gas business has never been more prosperous than it has been since the organization of these societies, by reason of the free and frank papers and discussions among ourselves as to what we are doing. All of us have practically given up this executive session notion, and the further we keep away from it the stronger and the better will our position be before the public. The publication of statistics of different companies by State Commissioners, where such Boards exist, has been a great benefit to us. The people have had for a long time the idea that we were working a gold mine. By the publication of our discussions, and of the testimony of expert engineers upon the stand, and in various other

ways, the public has finally been educated to the point of knowing that the gas industry is simply one of the great manufacturing industries of the country; that it must be conducted with economy; that its raw materials must be purchased with care and judgment, and that the men in charge must be skillful, or else the business does not pay. The public have learned that we do not work in lodes of virgin gold, but that we are earning our little percentage or dividend by the same skillful management and the same care for details that the linen or woolen manufacturer employs in his business. The sooner the public get this idea fairly planted in their minds the better it will be for us, and the fewer raiders there will be going up and down the country seeking municipal aid to enter into competition with us. The sooner the public realize that we are giving them gas at as low a price as it is possible to make and to sell it at a living profit, the better it will be for all of us. I am opposed to any action being taken here to expunge from the record anything that has been said upon this subject.

Mr. Copley—I have been the victim of too much executive session in several instances. In the town in which I am connected with the gas business I found that the one thing which has made the relation between the company which I represent and the citizens most pleasant, was a piece of work which I did in compiling some statistics about a year ago. I took the reports from Massachusetts for eight or nine years, and went over the actual amount of money invested as capital and the gross receipts in each town, and showed the people of my own city what a very small percentage on the actual money invested by the gas companies in the various cities the net profits bear to the gross receipts; and I assure you that almost every citizen who had no stock in the gas company believed until that time that the net profits amounted to a great deal more than the actual gross receipts. I believe, with Captain White, that any scheme which will give to the gas manager reliable statistics that he can present to the people—reliable figures from sources of integrity bearing upon the gross receipts and the net earnings of gas companies—will put in his hands the greatest peacemaker that he has ever had. I found that so in my own case.

Mr. Clark—It seems to me that Mr. Greenough has presented a very able argument in support of a certain theory which has been attacked by some and supported by others. Gentlemen who are differently situated from Mr. Greenough have different opinions. It is somewhat a local question doubtless, and the Association is not at all committed to it; but all this talk that I am indulging in, and the rest of us, about the importance of it will tend to give it importance, and I think that rather than expunge from the minutes what has been said in support of his argument, we had better expunge from the minutes what has been said about executive sessions. (Applause).

Mr. McIlhenny—I do not want to be misunderstood in the statement I made. I agree fully with the views expressed by Mr. Clark as to the benefits that the gas business has derived from the publicity of proceedings; but while I realize that that is the safe and proper course, yet there is reason in all things; and the whole question simply comes as to what we might consider one of legislative action. It is well known in a practical way that, so far as that particular phase is concerned, it is well sometimes to not tell to our neighbors everything that we know.

The President—If the discussion is closed, Mr. Greenough will have the floor.

Mr. Greenough—I do not know of anything more unsatisfactory to a man than to have written a paper, and have read it, and then not have anybody pay any attention to it. It is at any rate gratifying to find that one's remarks have excited interest. I do not know that there is very much left for me to reply to in what has been said, because substantially every argument that has been brought against my paper by one gentleman has been answered by some other gentleman, and answered as I would have done it myself. There are only one or two things that I want to say in continuation of the discussion. And I say, first, to Mr. Humphreys, in regard to the coke oven business, that I do not wish him to think I am slurring that matter over, or that I am not attaching sufficient importance to it. It is possible we may be able to enrich economically with water gas so as to make that gas as cheap and as good as ordinary coal gas. It is largely a question of the value of the residuals; it is a question that has to be worked out. If he is going to enrich his gas from 10 or 12 to 16 or 17 candles, and still leave the body of his gas coal gas, I think it will make it smoke. I do not think he will burn the enricher satisfactorily. I may be entirely mistaken about that, as I may be about all the other points in the paper. It is a question that more than one has got to try. In regard to Mr. Clark's remarks about my lacking the spirit which enabled Hooker to capture Lookout Mountain, I may say that Hooker knew enough to come up to the mountain on which we are standing, and he captured that part of the mountain which could be taken, which was where the grade was not so steep as at the foot of the hill. I have been led to my views on this subject by watching the effect of high candle power gas. They are supposed in Boston at the present time to be sending out 25 candle power gas—perhaps more; but I venture to say that there is not a large hotel in Boston that is not lighted by electricity. I think that the electric light has made more serious inroads into their business in Boston than it has in our business in Cleveland. I have not undertaken to get back the large hotels, theaters and clubs from the electric light companies, but, by the aid of the Welsbach burner, we have put out an enormous quantity of electric lights in small stores; and the business of the electric light companies in Cleveland, as compared with 80 cent. gas, is a profitable business as compared with what it is in Boston with $1.25 gas, or $1 gas, as at the present time. I do not think there is any possibility of getting the first class hotels in large cities, or the theaters, or clubs, back again into the use of gas. That has been my experience. In smaller cities, where electricity has cost more money, the condition of things may be different. But where you can produce electricity on a large scale you can produce it very cheaply, and very much cheaper than you can on a smaller scale. I do not think there is any use of going after that business very much by increasing your candle power for that purpose. As far as Mr. Jenkins goes, I think he has been answered by Mr. McDonald and by Captain White. I may say I do not think the man who drives along the street stands on the same basis as the man who tears up the streets, and in many cases lays large gas mains in the streets to the great inconvenience of the people who live on that street; and although the gas company is supposed to put the pavement back in as good condition as it was before it was torn up, it is very rare indeed that it does get the pavement back in just the same condition as it was before the pipes were put there. I claim that what is fair for us should be applied to electric light companies, to telephone companies, to the street railways, and to any of the other companies which claim the right to use the streets wherever they please and when they please. What Mr. McDonald says as to what is attempted to be done to the owner of a house on the street by the street railway that goes past his door is perfectly true; but that is the strongest case that can be put. It is also annoying to those who do not care to use gas to have the street torn up. I do think, also, that the man who pays large taxes should be relieved, to some extent at least, from payment for this. As far as Gen. Hickenlooper goes in his suggestion of resemblance between the animal who lost his tail and the Cleveland Gas Company, "I deny the allegation and I defy the allegator." The Cleveland animal walked promptly up to the block and distinctly proposed that it should have a small piece chipped off from its tail; and did so because the Company believed that it was policy. It has proved to be good policy, and is policy founded, in my judgment, on wisdom.

Gen. Hickenlooper—Permit me to say that that is hardly in accord with the reported proceedings of the negotiation.

Mr. Greenough—Reported proceedings of negotiations, as no other one knows better than Gen. Hickenlooper, do not always give all the facts. When the settlement actually took place in Cleveland the proposition for a tax upon the receipts of the Cleveland Gas Company was made by the Cleveland Gas Company; and it has seen no reason to regret it from that day to this. I think the General will come to that same conclusion himself. There was a time when, I remember, that the skin was pretty nearly taken off my back by Gen. Hickenlooper because I proposed a gas commission; and I never expected to live to see the day when he would read a paper proposing a gas commission for Ohio. I have my hopes that when the General's present contract runs out he will put in his proposal to the City of Cincinnati to pay it a percentage on his receipts.

General Hickenlooper—It is not that I desire to prolong the discussion at all, but I do object to being placed in a false position. I have not proposed a gas commission for Ohio. I said distinctly in my paper: "If it be deemed the part of wisdom to in the future draw tighter the lines of governmental control, it should be done with great care, intelligence and absolute impartiality; to the end that the interests of the public, the reward of labor, and the rights of capital, shall receive equal consideration and protection, through a department to be especially entrusted with the performance of the delicate duties of such a position." I have not myself advocated the establishment of a gas commission. I am a believer in the general rule that it is best to let well enough alone. We are satisfied with the conditions as they exist in Cincinnati to-day, and hence I am not to be considered as a prime mover in any innovation or new arrangement.

Mr. Greenough—Then I did the gentleman an injustice, and I apologize.

Mr. T. D. Miller—I would like to ask Mr. Greenough how the sales per capita in Cleveland compare with the sales per capita in Boston.

Mr. Greenough—I cannot tell you. I do not know. I have no figures in my head about that, but I am inclined to think that if you take the whole city of Boston together, including the suburbs, the sales are larger per capita in Cleveland. I do not believe that in any section of the country (except in a part of New York) do they burn as much gas per foot of main as they do in old Boston,—that is, in what constitutes the territory of the old Boston Gas Company, where the residence population is about 130,000 or 140,000. But, if you take the city through, and include alike the business parts and the places where the people live, such as Roxbury, Dorchester, South Boston, East Boston and Cambridge, I am inclined to think that the consumption per capita is larger in Cleveland than it is in Boston.

On motion of Captain White the thanks of the Association were voted to Mr. Greenough for his paper.

The Association then took a recess until two o'clock P. M.

Second Day—Afternoon Session.

The Association met at 2 P. M.

The President—The first business in order will be the reading of the report of the Committee on the President's Address.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. Jenkins read the following report:

Your Committee have considered with interest and profit to themselves the admirable address of President Littleton. They commend it entire to your careful consideration. They further recommend as follows:

That action be taken toward the formation of some plan whereby the proceedings of the annual meeting of our Association may be published in pamphlet form for the use of the members.

That the Board of Directors so amend Article I., Section I., of our By-Laws as to permit the admission of persons to active membership who are qualified to do good service both in and for the Association.

That the method of electing officers be changed so that nomination and election shall be made in open session.

While the above seems to your Committee to cover all the points upon which they can properly make special recommendation, they wish to record their belief that, as suggested by President Littleton, the formation of State organizations for the education of the public upon economic questions of interest to gas corporations, and the protection of gas companies from ill advised and ill-considered legislative action, would be legitimate and beneficial.

E. H. JENKINS,
WALTON CLARK,
W. M. EATON. } Committee.

The President—What is your pleasure concerning the report of your Committee?

Mr. Howard—I move that it be received, filed, and adopted.

Mr. Chollar—The Chairman of the Committee reports a recommendation that the Board of Directors be authorized to amend Article I., Section I., of our By-Laws; but they have no power to do that.

Mr. Jenkins—It was simply a recommendation that the Directors take the matter up and prepare a proper amendment for the action of the Association.

The President—According to the Constitution of the Association that amendment would have to be submitted before the adjournment of this meeting in order to receive consideration at our meeting next year; otherwise two years would have to pass before the amendment could be operative.

The report was then adopted, on Mr. Howard's motion.

REPORT OF COMMITTEE TO NAME PLACE OF NEXT MEETING.

The President—The next business will be the report of the Committee on the next place of meeting.

Mr. Copley, Chairman of the Committee, read the following report, which was, on motion, adopted:

To the President and Members of the Western Gas Association:

Your Committee, appointed to select a meeting place for the 20th annual convention of this Association, to be held in 1897, beg leave to submit the following report:

After carefully considering the various qualifications of the different cities comprised within its territory, the Committee unanimously decided to recommend Cincinnati as the next meeting place.

I. C. COPLEY,
J. W. MURDOCK,
J. T. LYNN,
GEO. T. THOMPSON,
JAMES FERRIER, } *Committee.*

ELECTION OF OFFICERS.

The President—We will next listen to the report of the Committee on the Nomination of Officers.

Mr. B. E. Chollar read the following report: Your Committee to whom was delegated the duty of recommending a list of officers for the ensuing year respectfully beg leave to report in favor of the following:

For President—W. H. Odiorne, Springfield, Ills.
For First Vice-President—Jas. T. Lynn, Detroit, Mich.
For Second Vice-President—Geo. T. Thompson, New York.
For Secretary and Treasurer—Jas. W. Dunbar, New Albany, Ind.
For Directors—(to serve two years)—I. C. Copley, Aurora, Ills.; H. W. Douglas, Ann Arbor, Mich.; C. W. Blodget, Brooklyn, N. Y.; Jas. Forbes, Chattanooga, Tenn.

Respectfully submitted,

J. B. HOWARD
E. G. COWDERY,
ALTEN S. MILLER,
THOS. D. MILLER,
B. E. CHOLLAR, } *Committee.*

The President—You have heard the report of the Committee. What action will you take in the matter?

The report was, on motion, adopted and the President instructed the Chairman of the Committee (Mr. Chollar) to cast the ballot of the Association for the election of the gentlemen named. In due time Mr. Chollar reported that the instructions had been carried out.

RESPONSES FROM THE OFFICERS ELECT.

The President—I declare the gentlemen duly elected to the positions designated. We shall be glad to have Mr. Odiorne tell us how pleased he is over the honor conferred upon him by his election to the presidency of this Association. (Applause).

Mr. Odiorne—(President-elect)—I heartily thank you, gentlemen, for the honor. Any gas man may well feel proud to be selected to preside over the deliberations of the largest Gas Association of the country. With your assistance, and with the assistance of our able Secretary, I promise that I will endeavor to have a No. 1, up-to-date meeting, in 1897. (Applause).

The President—We shall be pleased to hear from our friend Lynn, the First Vice-President.

Mr. Lynn—Mr. President and Gentlemen, I thank you for the honor which you have conferred upon me. I consider it a great honor to be elected the Vice-President of, if not the largest Association in the country, what I consider the best.

The President—We shall be pleased to hear from our Second Vice-President.

Mr. Thompson—I think the association made a mistake in nominating to so honorable a position so young a man. I consider the editorship of the "Wrinkle Department" quite sufficient honor for any one man; but I accept with a great deal of pleasure the nomination so kindly tendered me, hoping that in a succeeding year, by the new form of balloting, I may be relieved from further promotion.

Mr. Chollar—The Committee on Nominations wish it understood that they want no aspersions cast on their judgment.

The President—The Committee are entirely right in their selections. The Secretary has not yet thanked the Association for his election.

Mr. Dunbar—I assure you I appreciate the honor conferred by electing me Secretary, and I shall endeavor, to the full extent of my ability, to faithfully perform the duties of the office. I thank you.

The President—If the Committee on Final Resolutions are ready to report we will now hear what they have to say; if not we will defer it until after we have heard from the "Wrinkle Department."

Mr. Humphreys—We are not yet ready. We are now struggling with the report.

The President—We will now take up the

WRINKLE DEPARTMENT.

The budgets of our Wrinkle Department have hitherto been composed of items on widely varying subjects, through almost the entire range of the divisions of gas manufacture and distribution. In the present collection, while giving place to the welcome contributions on other portions of our work, the Editor devotes especial attention to features connected with water-gas manufacture, and departs somewhat from the plan observed heretofore of presenting the items singly as received from individual contributors, in the attempt to secure greater coherency between the accounts of the several devices consecutively described.

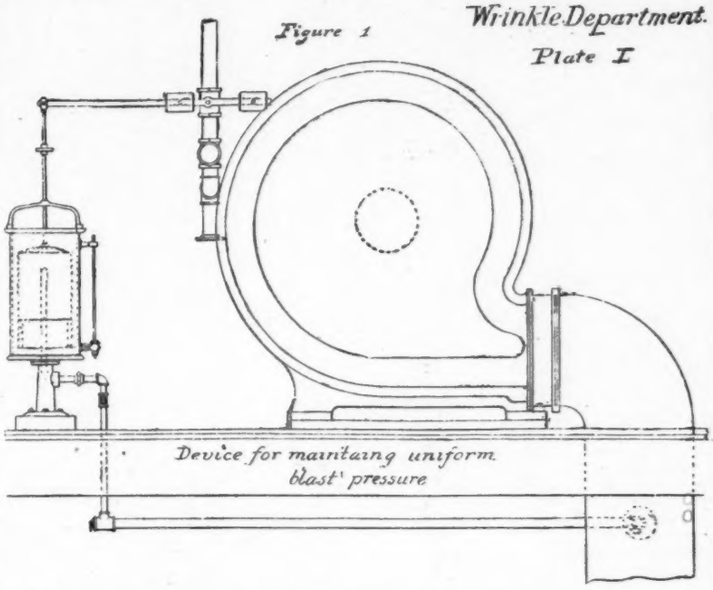
Water Gas Devices.—Regulating the Air Blast.—An important condition to the attainment of satisfactory results in water gas making is the character of the air blast, on which nearly one half of the work depends. In several plants—those at Chicago and at Toledo, for instance—the plan of regulating the blast is a modification of that employed in governing the vacuum drawn by an exhauster. We are indebted to Mr. John Williamson, of Chicago, for the drawing (Fig. 1, Plate I.) showing the adaptation to this purpose of a weighted float similar to that of a Mackenzie compensator, whose operation, actuated by any tendency to insufficiency or excess in the blast, maintains a uniform pressure on the air pipes whether any or all blast valves are open, or if all are shut. We are assured that this uniformity, at a properly adjusted high pressure, is materially helpful in attaining a large production with economy.

The practice at one of the Laclede plants at St. Louis presents some features of novelty, in departing from the custom of throttling the steam engine between blasts. Owing to the location of the blower room next the retort house and coal pockets, where flying dust and grit are unavoidable, a type of self contained engine was considered preferable, and 25 H. P. Westinghouse standard engines were chosen. As these run at 390 revolutions per minute, throttling the steam or changing the speed was undesirable. Experiment quickly showed that a proportion between driving and driven pulleys on the countershaft, which would give sufficient blast when the time of blowing on the two machines coincided, would raise the relief valves and result in waste if the same conditions at the blower existed during the run. An additional blast gate was then provided, pierced with a 4 inch hole, and weighted, attached to a chain running over spools to the operating floor above. Though both blowers discharge into a single air main, but one of them is run at a time. When starting up, this pierced gate is substituted for the solid gate—in the same slide—and raised while blasting, then lowered during the run. A pressure is thus maintained on the pipe at all times, while the engine load is materially reduced when the blast is not entering the machines. The relief valves are no

Wrinkle Department.

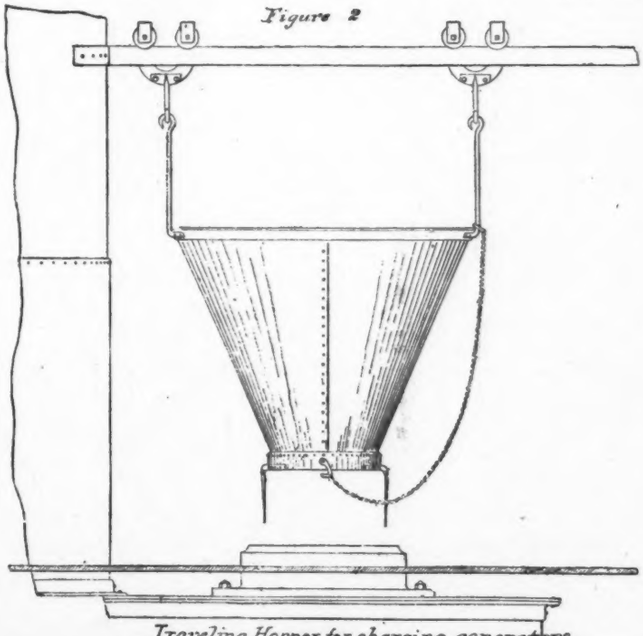
Plate I

Figure 1



Device for maintaing uniform blast' pressure

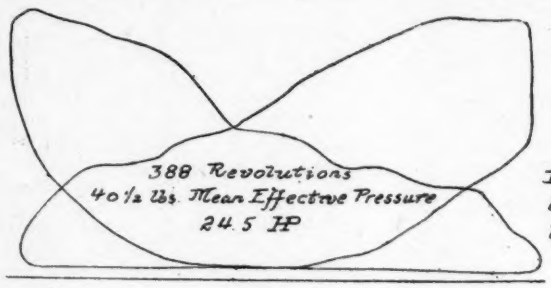
Figure 2



Traveling Hopper for charging generators.

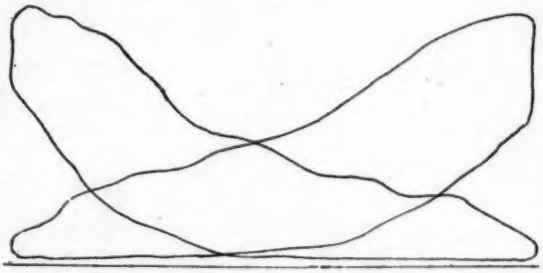
Wrinkle Department.

Plate II.

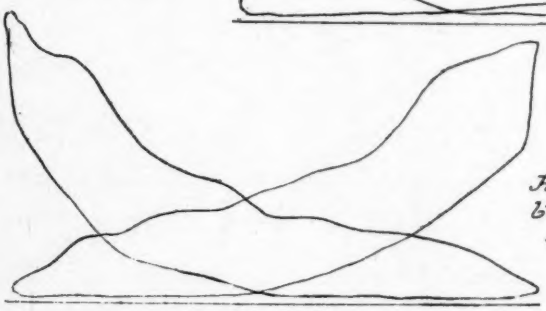


388 Revolutions
40½ lbs. Mean Effective Pressure
24.5 HP

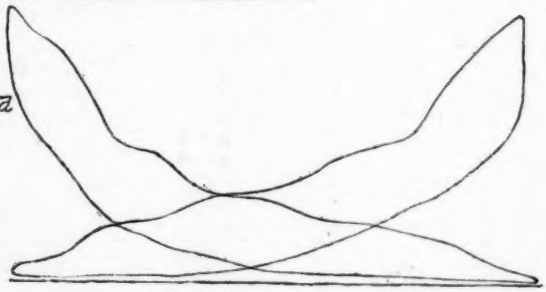
Blast valves open on both Generators and both Carburetors



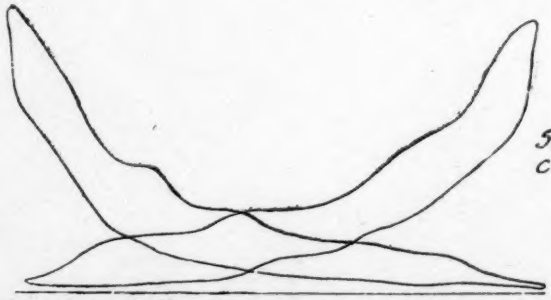
Blast on one Generator and on one Carburetor
392 Rev
30½ M E P
18 67 HP



All valves shut
blast gate open
394 Rev
26½ M E P
16.15 HP



4" circular opening in closed blast gate
396 Rev
20½ M.E.P
12 37 HP



Solid blast gate closed
398 Rev
15½ M.E.P
9.6 HP

WRINKLE DEPARTMENT.

Plate III.

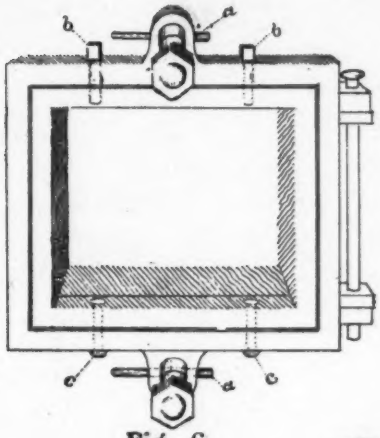


Fig. 6.

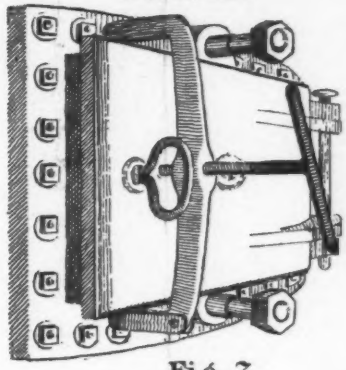


Fig. 7.

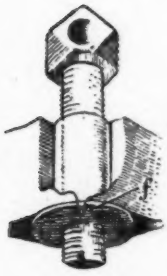


Fig. 8.

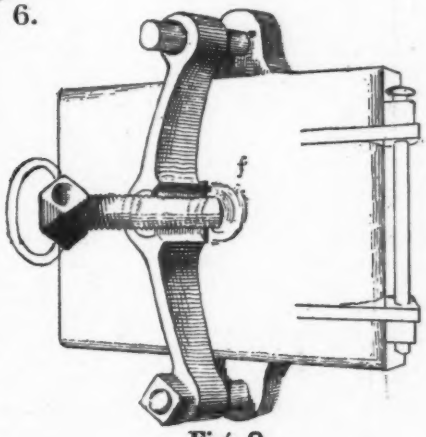


Fig. 9.

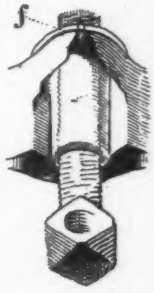


Fig. 10.

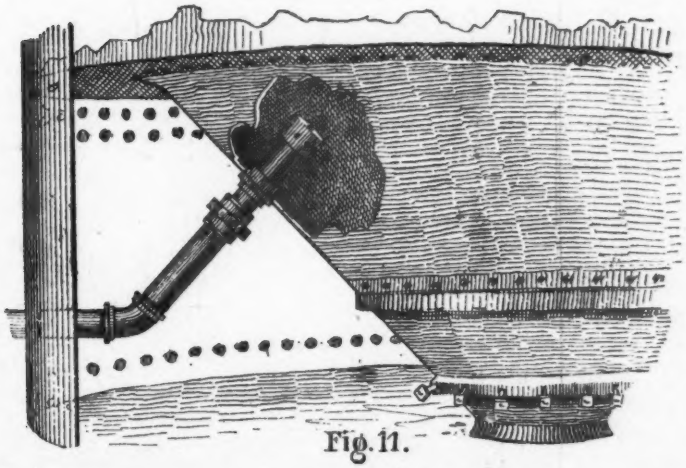
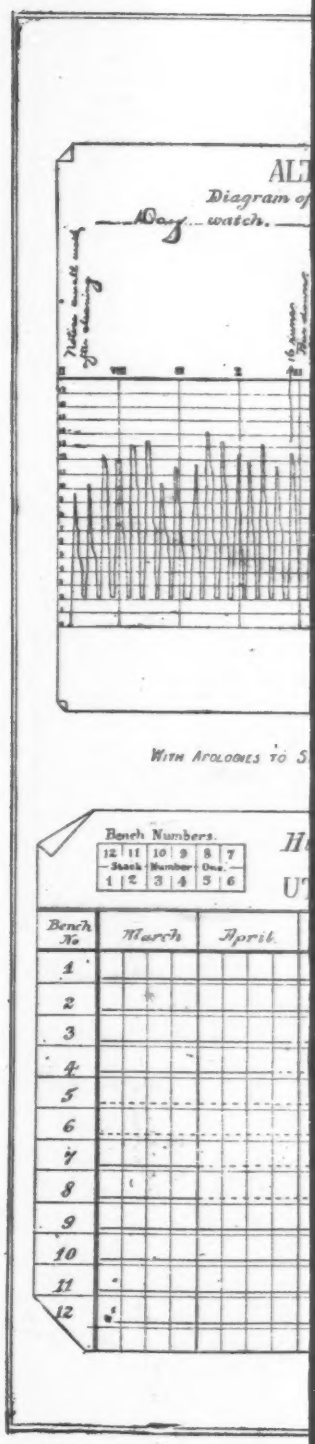


Fig. 11.



UofM

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WRINKLE DEPARTMENT.

Plate III.

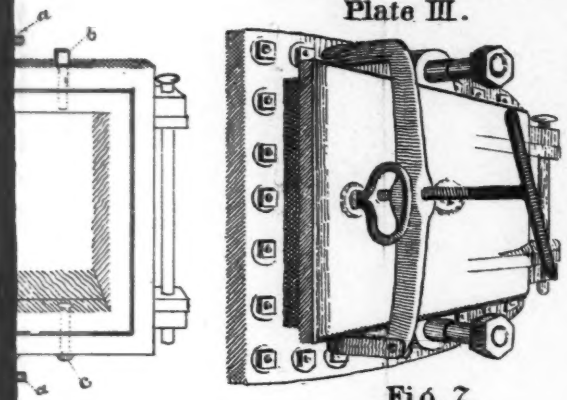


Fig. 7.

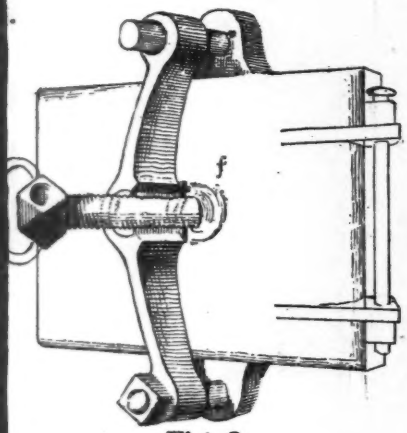


Fig. 9.

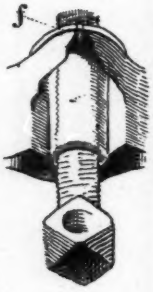


Fig. 10.

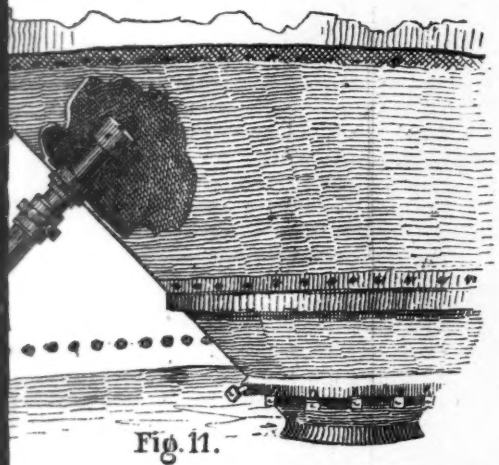


Fig. 11.

Wrinkle De

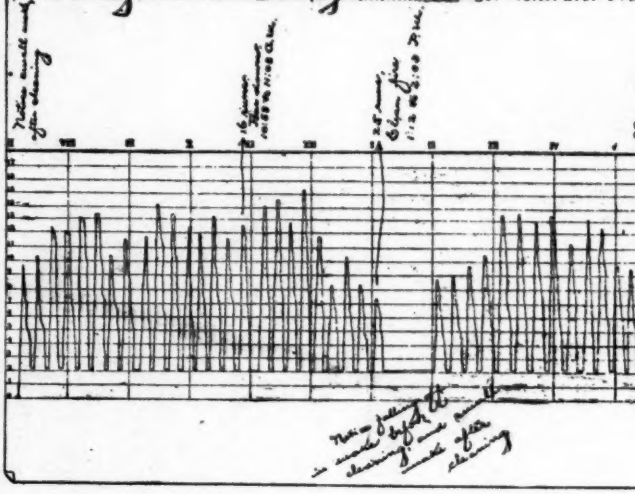
Pla

Figure 12.

ALTRURIA GAS LIGHT CO

Diagram of Pressures on Water-Gas Machines

Day watch. May 12. 1895. Generator No



With Apologies to Sir Thomas More, W. D. Howells and H. D. Walbri

Figure 13.

Bench Numbers.

12	11	10	9	8	7
Stack		Number		One	
1	2	3	4	5	6

History of Each Bench.

UTOPIA GAS WORKS.

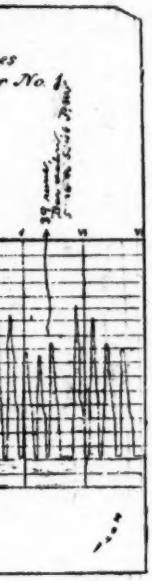
Solid line —

Dotted - - -

Blank

Bench No.	March	April.	May	June	July	August
1						
2						
3						
4						
5						
6			Mud, Clay & Coke retorted;			
7			15" x 24" x 96"			
8						
9						
10						
11						
12						

Department.
Plate IX.



VALBRIDGE

ine ——— Working
- - - - - - Idle
Rebuilding

August	September

WRINKLE DEPARTMENT
Plate V.

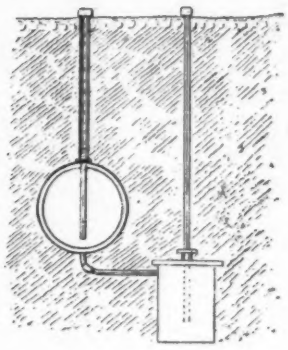


Fig. 14.

SAFETY - PIPE,
INDIANAPOLIS FORM.

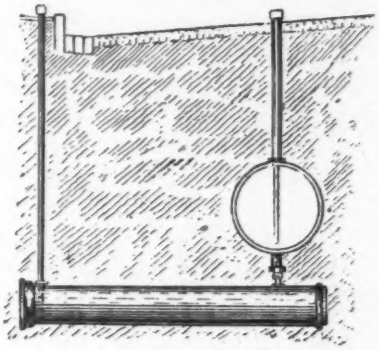


Fig. 15.

SOUNDING - PIPE
ST LOUIS FORM.

FERRIER'S ARRANGEMENT
OF CHOLLAR'S PIPING TEST.

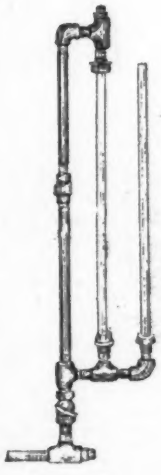


Fig. 16

MAC MILLAN'S
PRESSURE - GUAGE.

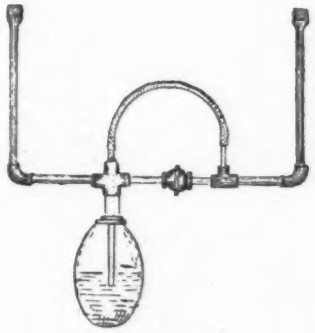


Fig. 18.

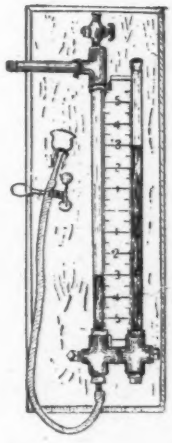


Fig. 17

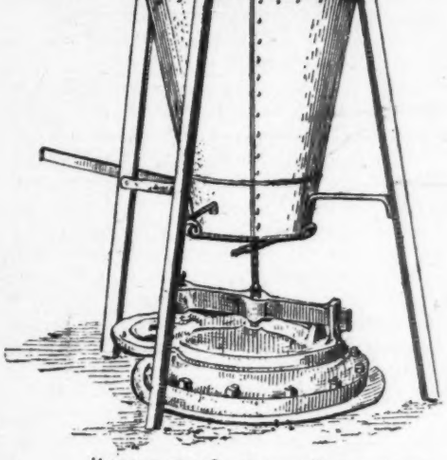
FERRIER'S
PRESSURE-GUAGE

U of M

longer raised by the blast. Indicator cards were taken from the engines before and after this plan was adopted, and graphically showed the saving, besides being of material aid in deciding on the valley sizes. Copies of the final cards are shown in Plate II.

Charging the Generator—Two novelties in the methods of charging generators are illustrated in our collection this year. Mr. William H. Odiorne, of Springfield, Ill., employs a hopper (Fig. 3) supported on three legs of angle iron, with a hinged door at the bottom, which is made to stand directly over the coaling door of the generator. The hopper holds seven bushels of coke, and can be discharged in twelve or fifteen seconds, while the gas maker may fill it at his leisure. It is not heavy, and may be set aside when barring down from the top.

Mr. George Light contributes a drawing (Fig. 2, Plate I.) showing the method of charging generators in use at Dayton, Ohio—an overhead carrier, for which several advantages are claimed as against the charger on wheels. A bumper is placed at the proper position on the rail, and causes the charger to stop directly over the center of the generator, thus avoiding the dropping of coke on the floor. A scale placed inside the hopper shows the quantity of coke charged. The apparatus is inexpensive, and its repairs are



HOPPER FOR CHARGING GENERATOR

Fig 3.

merely nominal. Mr. Light adds that this same style of appliance, with an additional traveling rail and carriage, may be utilized in the purifying house for filling boxes, the oxide being dropped whenever desired, without shoveling.

Devices for Clinker Doors.—The clinker doors and their accessories receive the most severe use of all the iron work about a water gas machine. Experience at St. Louis with a well known type of door has dictated several minor changes, some of which may be of value in other plants and with other makes of machine. *First*—The iron liners were originally secured in the doors by cap screws, as at "b," Fig. 6, Plate III. The threads of these were found to burn and stick, and the screws would often break when it was desired to change the liners. They were accordingly removed and replaced by rivets; see "c", Fig. 6, Plate III. When the liner is to be withdrawn—an infrequent requirement—the rivet-head is simply cut off. *Second*—The pins which serve as lugs for the cotter bars are furnished threaded into sockets in the door-frames; and as the lower pin of each pair is midway the bottom of the door, it is frequently struck by the heavy bars in clinkering. After a number of pins had been broken in this way and replaced with new ones like the model, we bored out the threads in the socket and made the pin with a plain shank instead, securing it by a keeper (key pin or keep in) passing through socket and bolt at a right angle. (See at "a," Fig. 6, Plate III.) The bolt or lug may now be readily removed when clinkering, and there is no thread in the socket to wear out and make the door frame useless. *Third*—The frequent breakage of these pins before the above plan was adopted suggested the use during repairs of a temporary cotter bar with grips instead of lugs, to clamp under the projecting edges of the door frame. One end of the bar, the one which is hung on the upper side of the door, terminates in a *fixed* hook or grip, while at the other end the grip swings from a bolt. A form may be used in which both ends are fixed, the appliance slipping on at the side of the frame, but this is not so handy. The temporary bar may be made from an old cotter, or is easily fashioned by any good smith. Fig. 7 on Plate III. shows it in use. *Fourth*—The constant use and heavy strains put on the cotter bars and screws to make tight the faced joint of the doors, soon wear out the screws. These are not difficult to make anew, but the wear also falls in no small degree on the thread in the bar itself, and this bar, nicely fitting the pivot and lugs, is not so easily replaced. So when the thread is badly worn we drill it out altogether, leaving the bar nearly as strong as before, since the hole is practically no farther into the iron than were the valleys between the threads. A bushing of gun metal is cast and turned to fit this hole, with a flange on one end; it is also threaded inside to receive the screw. The bushing is slipped into the hole in the cotter bar with its flange on the inner side, next the door, thus receiving the thrust of the screw. A notch in the edge of the flange, shown at "f" in Figs. 8 and 10, Plate III., engaging with a pin in the bar, prevents the bushing from turning. No further wear will then come on the bar, and the bushing will wear rather than the screw. *Finally*, as regards the clinker doors, the practice of bricking up these doors when putting fire into the generator, or after "pulling" the fire when much clinker has gathered, has been found to save the liners and shell materially. The bricks are built 9 inches deep, flush with the inside of the lining, and plastered with yellow clay, before fire is introduced. At the first regular clinkering which follows the bricks are pulled out, and the iron plugs substituted after the cleaning.

Steam Nozzle—Some trouble having been occasioned by burning out the cap nozzle on the steam connection under the generator grate, which could only be reached after fire had been withdrawn from the machine and the shell somewhat cooled, the method of connection shown in Fig. 11, Plate III., was adopted to permit its repair from the outside. The pipe is 1 inch, so a 1 1-2 inch opening admits the cap freely, and is closed by a bushing. The opening is made sufficiently below the junction of the conical ash pit with the main shell to give space for a union just outside the bushing.

Protecting the Oil Nozzle—The nozzle or spraying attachment for introducing the oil is generally exposed to a considerable degree to the danger of burning out during blasting up. When a machine is temporarily standing out of use, but still hot, or while being brought to a working heat after a shut down, this may of course be avoided by removing the nozzle or injector; but danger between runs is best avoided by connecting a steam pipe into the oil feed just before it enters the machine. A very small opening on the valve will admit sufficient steam to prevent injury to the nozzle from external heat.

Admitting the Oil—A most satisfactory manner of controlling the admission of oil is by means of an asbestos packed cock between the usual oil valve and the machine. The valve may then be set at the point which experiment shows is best for admitting the required quantity of oil in the given number of minutes, and allowed to remain in that position; a quarter turn of the cock throws the rest of the pipe fully open, or completely closes it. The wear on the valve is reduced to the minimum, and the asbestos packing of the cock permits it to be turned almost without limit, without sticking or leaking.

Pressure Register for Recording Generator Work.—On page 40 of the issue of the AMERICAN GAS LIGHT JOURNAL, on July 9, 1894, appeared an article from the pen of Mr. Frederic Egner, of Norfolk, Va., detailing his experience with a pressure register connected to the outlet of his water gas machine, to show the periods of blast, run, and clinkering. A correspondent who signs himself our "Well Wisher" has sent us a chart (from the principles of which our Fig. 12, Plate IV., was made) which was taken from a register connected as Mr. Egner describes, and adds the following interesting details: "The register of gas making as derived from Mr. Egner's wrinkle is only adapted to one set; where two or more are running, a separate gauge should be rigged for each set. In weighting the bell of an ordinary register to adapt it for the use under consideration, I fasten strips of lead to the sides of the bell, hence as it rises out of water with each increment of pressure an increment of weight is added, due to the relative increase of weight of the portion of lead no longer submerged. I connect the register

to the inlet of a tubular condenser, beyond which is the relief holder.

"Taking the average height of all the runs as registered on the chart, and comparing with the actual day's result per run, after a number of charts have been taken off and compared, it is safe to draw a few general deductions from a subsequent chart. The chief value, however, is as a check on the regularity of gas making, just as a watchman's clock is an indicator of his behavior.

"The rise and fall of the relief holder does not materially affect the register, there being only a few tenths difference between the different lifts, while the pencil registers a range of 8 or 10 inches of back pressure. The larger the circumference of the drum, the broader the space covered by a run; indeed, the clock work may be changed to revolve the drum once in 12 hours instead of in 24, and if the pencil or pen be provided with two colors of ink or lead, alternated each 12 hours, you would have a day and night record superimposed in different colors, and readily distinguishable." (Despite the ingenuity of this last suggestion, the Editor imagines that it would be found more satisfactory to change sheets each 12 hours than to change colors. The times of clinkering on the two watches do not exactly coincide, and the lines traced are necessarily heavy and close together at best; the confusion of such a doubly marked sheet would therefore seem to be an objection not overcome by any advantage in superposing the charts.)

Connecting the Test Light.—Our "Well Wisher" also forwards some notes on connecting the test light for a water gas machine. He reminds us that the test light should be connected with as short a run and as small a size of pipe as possible, and close to the machine, in order the changes in the quality of gas made shall quickly show. From the outlet to the first scrubber he runs a 1-2 inch pipe downward a few feet, then leads it into the reduced side outlet of a 2 inch tee, one end of which is plugged for access in cleaning, while to the other end is attached a piece of 2 inch pipe about 2 feet long to serve as a tar catcher. The outer end of this pipe terminates in a 2 inch cross, plugged at the end, connected with a sealed overflow for the tar on its lower outlet, and reduced to 3-8 inch at the upper outlet, from which pipe of that size leads upward to the purifying pot, above which is the test light in a case to protect it from draughts. The hot gas is cooled by the run of pipe, and most of the tar is deposited in the horizontal washer of 2 inch pipe, through which it has to bubble. This arrangement gives a quick course of gas to the light, with a steady flame, and the burner tip needs cleaning but once a day instead of once a run.

Ventilating Scrubbers, etc., while Cleaning.—In cleaning out the washers and scrubbers of his water gas plant, Mr. James Somerville, of Indianapolis, writes that his men have been able to stay in the shells only a short time, the work being trying and exceedingly slow. He accordingly made a connection at a convenient point on the blast pipe between blower and generator, attaching a 4-inch light galvanized iron pipe, with slip joints so that it may be connected and disconnected in a few minutes. He then ran this pipe to the manholes of the washer and scrubber, having each piece marked to suit the position of its use for ease in putting together. No valves are used. When men enter the apparatus to clean it, the blast is turned on, and work can be carried on without any trouble.

Miscellaneous Devices.

Recording Bench Histories.—Taking leave of the water gas division, we have a chart from Mr. Irvin Butterworth, of Columbus, Ohio, for recording graphically the history of each bench in a coal gas plant. "First, number the benches, and then make a chart having as many light horizontal lines as there are benches, and the spaces between the light perpendicular lines represent weeks. Make every fourth perpendicular line heavy so as to make the spaces between them represent months. Then as time goes on, indicate the history of each bench by marking the horizontal lines somewhat as follows: Draw solid lines for working benches, dotted ones for idle benches, and leave the lines blank for benches that are rebuilding. ***Where the rebuilding of benches is indicated, the name of the maker of retorts used, and the size of same, etc., can be readily shown; and also, if desired, other data as to any repairs that were made upon the furnaces of these particular benches, etc. It is also easy to indicate when retorts were decarbonized. By making the charts uniform, and pasting each year's chart to the end of the chart for the preceding year, the record can easily be made continuous indefinitely. Like many other such records it grows more valuable with age. We have used this wrinkle ourselves for several years and find it very convenient and satisfactory." A chart on the lines of that received from Mr. Butterworth is given on Plate IV., in Fig. 13.

Pressure Gauge.—Two modifications of the usual form of pressure gauge have been contributed by friends of the Wrinkle Department, the first being that of Mr. George MacMillan of La Crosse, Wis., whose ingeniously simple device is shown in Fig. 16, Plate V. Mr. MacMillan writes that the gauge from which his photograph was taken was a 22-inch instrument without scale, now in use on the outlet of the rotary exhauster at his Appleton (Wis.) works. The picture is practically self explanatory, but to make its construction a little clearer he adds that the unions used to connect with the glass tubes were taken from condemned meters, of which there are usually several at every gas works. The male part of this union is tapped with a 1-4 inch gas tap, to receive one end of a short 1-4 inch nipple, the other end of which screws into the fitting, as shown. The nipple marked "a" in the sketch is plugged gas and water tight with lead, or may be a solid piece of iron. All the other parts are made of common gas pipe and gas fittings, 1-4 inch size. The materials necessary to make such a gauge, of almost any length, are always so accessible and inexpensive, that the design is certain to be of some practical interest to the fraternity.

Pressure Gauge with Adjustable Water Level.—Mr. James Ferrier, of Columbus, Ga., sends the second item regarding gauges, and his suggestion is illustrated in Fig. 17, Plate V. His device has the upper tee with pet cock, and the lower crosses and short nipple connecting them, attached to a suitable board by pipe straps. The glass tubes are connected with the fittings by boring out the threads of the latter, then slipping a piece of rubber tubing or a bored rubber stopper over the glass and into the fitting; a perfectly tight joint is thus obtained. The essential novelty of this arrangement lies however in the use of the rubber tubing, pinch cock, and funnel, by which the level of water in the gauge may be adjusted to any point by raising or lowering the funnel—which is supported by a pipe hook—and slightly opening the pinch cock. The tubing and funnel also provide an easy means of replenishing or draining the gauge without the necessity of removing the plugs. (A modification of this arrangement is seen in Hempel's analytical apparatus, in the method of transferring gas between the burettes and pipettes.)

Using Rosin in Pouring Lead Joints.—In the realm of "Distribution" the Editor acknowledges with pleasure several items of importance. Mr. H. L. Rice, of Milwaukee, calls attention to the advantage of using rosin in running the lead joints on cast iron main pipe of all sizes larger than 10 inches. "The mode of use is to place a few lumps of rosin in the pouring hole made by the clay on the pipe, powdering the same, and shoving as much as possible of the dust inside the bell. The lead as poured passes over this powdered rosin, and carries it before it into the joint. The rosin greases the entire joint, and prevents the lead from cooling too suddenly against the cold sides of the pipe, and gives a smooth and even joint." Mr. Rice adds that he has had occasion to pull apart a good many taper joints in 24 inch pipe designed for use in the bed of a river, in which joints rosin was not at first used, but was afterward brought into service. The joints made without the rosin, although carefully poured, when pulled apart were found to present a slightly roughened surface, showing the influence of too rapid cooling; in one case where the pouring was from two ladles, through misjudgment of the quantity required, the joint was thoroughly bad. After the rosin was used, however, the joints were invariably smooth and even, and the spigot end of each pipe when pulled out showed that it had been oiled over its entire surface by the rosin. In another case of a double pouring, rosin being used, the joint was found to be acceptable. "Should moisture be present, the rosin almost entirely prevents the spattering of the lead which usually takes place under these circumstances."

Inflating Gas Bags.—Mr. Ralph Woodward, of New Rochelle, N. Y., communicates the following suggestion: "Having had trouble in blowing up rubber gas bags tight enough to entirely hold back the gas, the idea occurred to me that by using a small bicycle pump such as is used to inflate tires, I might save my lungs and get the bags tighter. It proved a success. The only care needed is not to force the gas bag too hard, or it will burst." As Mr. Woodward prefaced his note with the remark that his suggestion might not be a new wrinkle, the Editor feels free to add that he has known a gasfitter's proving pump to be used in the same way. If the form

of indicator bag made by certain manufacturers is used, having a small bag on the rubber stem outside the main pipe, the progress of inflation may be watched, and greater safety attained.

Gas Bag Holes, Cut vs. Drilled.—It may be remarked in passing, that one of the difficulties in handling gas bags arises from the danger of tearing the bag when passing it through the hole in the pipe, owing to the presence of splinters of iron from the drill, either in the pipe, or at the last thread in the opening. This has led to the practice of cutting hand holes instead of using drilled openings, except on the smaller sizes, and is particularly convenient on exposed mains about the works. The use of a section of sheet gum about twice the size of hole, and pierced in the center for the bag stem, is an additional precaution both as regards tightness of the fit and lessened danger of tearing at the bag hole. The hand hole may be cut and cap screw holes tapped almost as quickly as a large drill tap can be driven through the main, and permits the pipe to be swabbed out, the edges of the hole to be smoothed, and the bag to be adjusted much more readily.

A Piston Plug for Main Laying.—But gas bags, while we must use them until a better device is marketed, are at best "mighty onsartin," and our plaudits and patronage await the inventor of a successful substitute. Mr. Donald McDonald, of Louisville, sends description of a device which he uses in laying new mains, to which his men have given the sulphurously suggestive name of a "go-devil": "It consists of a piston attached to a rope, which is put into the pipe to begin with, and no gas bag is used. Before the joint of pipe is put in place, the rope is run through it, and as soon as the joint has been made tight the piston is pulled forward into the last length laid. In this way we always have gas behind us to test our pipes, and can also give gas service without waiting until the whole main is completed. Of course this piston leaks slightly, and in case of any considerable time elapsing between the laying of the joints we put the rope inside the last joint laid, and then close it up with a rubber plug such as plumbers use in testing soil pipes. The piston may, of course, be made in many ways. We make it with a block of wood on which is joined a sheet of rubber in such a manner as to make it take a shape something like that of a parachute. This is amply tight for handling natural gas. It might be necessary, however, in handling artificial gas to take means for making this piston more completely gas tight." The Editor has heard that in New Orleans a contrivance known as a "rat" has been used to clear out obstructions in the mains, being driven through by water pressure. The arrangement was described as consisting of *two* pistons connected by a rod, in order that they might maintain a position perpendicular to the line of main, and pass through tees or crosses at street intersections without difficulty. Each piston was made of two discs of metal, between which was a circle of leather slightly larger than the inside diameter of the main. This contrivance is mentioned because it seemed another practical device for carrying out Mr. McDonald's interesting plan.

Safety Pipe for Drip Boxes.—An important safeguard for drip boxes is described by Mr. James Somerville, of Indianapolis, who connects the drips about his works in the manner shown in Fig 14, Plate V. It will readily be seen that if the small pipe leading from main pipe to pot becomes stopped up—as too frequently occurs in certain situations—the drip will show dry, and yet the main may be half full of water. The safety pipe, as Mr. Somerville entitles it, is run through the main nearly to the bottom, and is carried to the ground level above just as is the drip riser. The drip man is instructed to try the safety pipe after pumping the drip at the riser, and if gas does not blow at the safety pipe, to pump from there also.

A recent experience in St. Louis caused the adoption of an expedient similar to this. A line of special main, deeply bedded to avoid other pipes nearer the surface, has a drip at a point where it passes below a 20 inch line. This drip is made of a piece of 12 inch pipe, plugged and capped, lying horizontally, and was connected to the main pipe by a 1 inch drain running with a bend, like that shown by Mr. Somerville. This drain became stopped up some time since, and could only be cleared by digging down and removing it, when it was found to be full of hard naphthaline. When replacing the drain the 12 inch pipe used as a drip was moved *under* the main as shown in Fig. 15. Plate V.; the drain was connected with an expansion joint directly between the pipes, and a sounding—or safety pipe like Mr. Somerville's was attached immediately over it—so that in addition to the use of the latter as a pump suction, a rod may be inserted and any obstruction entirely dislodged.

Improved Form of the "Delicate Test for Piping."—A very practical construction of the bottle for testing gas piping, described in the budget of kinks of 1895, is used by Mr. James Ferrier, of Columbus, Ga., who writes as follows: "I was not slow in making use of the admirable device for testing piping suggested by Mr. Chollar in last year's Wrinkles. Finding, however, that the apparatus as then described was rather a fragile one in the hands of workmen, I adopted the arrangement shown in the sketch (Fig. 18, Plate V.,) which I have used with the most satisfactory results. The bulb shown is a glass oil cup of the inverted pattern, and is readily obtained from dealers in steam fittings. As these cups are furnished with pipe threads, the ease with which such a device may be rigged up is evident. The connection between the cross and the glass tube is made by means of a rubber stopper, and to obtain a tight joint, the threads of that branch of the cross are bored out. The opening of the oil cup must be made at least 1-4 inch larger than the external diameter of the glass tube. The upright nipples shown in the sketch are furnished with the standard male threads of a meter; a set of these nipples corresponding to different sizes of meters should be provided. In making a test, all that is necessary is to substitute the tester for the meter."

It is interesting to note how certain of the Wrinkles described in this Department on former occasions have later been devised by other than their contributors to our Proceedings, or have been the subjects of thought and discussion in other channels of technical interest—in both cases doubtless without the knowledge on the part of the other writers that the details had been brought before our conventions. The object of Mr. Jenkins' device for by passing the lower tray of a purifier (Wrinkles of 1894) is now covered by Mr. F. Southwell Cripps' English patent; and Mr. Chollar's arrangement of a test for house piping, described in 1895, and used by him for many years before, was patented in almost identical form in England early this year, and shown in the London *Journal's* Register of Patents, Feb. 4, 1896, page 228. Mr. Odiorne's device for pulling up the rod when barring for street leaks was shown, but with wheels added, in the Wrinkle Department of the Pacific Coast Gas Association at the meeting following ours; but reference was made in their description to our prior account of the similar device. Other instances might be cited. But the principles of certain contrivances which we have described have been well known long before their appearance on our pages, and their accounts were only given because embodying some alterations from previous methods of attaining desirable ends. It will, therefore, be seen that these matters are by no means mentioned as a claim that we are always the first to describe the designs which have been presented, or that originality is inherently a part of our work—but only to emphasize the position we have taken in *endeavoring* to obtain items which were new, or if some were not altogether unknown to choose the one which, like the harvest moon, was an old friend with a new phase.

In addition to the office of the Wrinkle Department in supplementing the Question Box, as was prophesied for it at its institution, the thought occurs to the Editor that it has a work to do as a "Suggestion Box." In our idle moments do we not often think of devices which we will some time work out, which are mayhap of little immediate use, but might be convenient under certain circumstances later? Upon some of these ideas we may have already worked in a desultory way, but not being altogether satisfied with our progress, while the object sought is not sufficiently vital to arouse our determination to solve it ourselves, we may be willing to outline the end to be accomplished, and let our brethren have a shy at it.

For instance, it has been suggested that a governor on the water gas blast pressure, similar in purpose and effect to that already shown, may be made by properly weighting and counterweighting a small bellows. Who will be the one to successfully arrange this? Again, a whistle tube has been arranged on the seal box of a water gas machine, to indicate low seal if the scrubber water was insufficient. This failed to give entire satisfaction because of the disturbance of the water during the run, especially at first; for, if adjusted low, it would not unseal in time to be of service, and if raised higher was like Aesop's fabled wolf annunciator, and sounded the alarm most of the time. This difficulty can be overcome; let its solution be sent to our Department.

Again, a positive device for controlling, measuring, and keeping

uniform the supply of water to a scrubber is much needed, and would repay attention.

Can an appliance be devised to push into a service pipe from the cellar, which, after clearing away minor obstructions, could be expanded within the pipe, enabling the presence of leaks to be found and their position located by putting pressure on the pipe from the cellar end, and measuring the length of rod which had entered when the leak was discovered? Of course, in a service with stop cock this would not be so available, and the stop cock itself will enable such a pressure test to be made for that portion of the service; but as it is a reasonable statement that quite as much of our leakage takes place from services as from main pipes, any suggestion promising even a morsel of relief is worth at least a passing consideration.

It is hoped that the discussion upon the contributions which are here collected will include many suggestions such as have been indicated, which will be worked up by our members and forwarded for the Wrinkle Department of 1897.

Discussion.

The President—We shall be glad to have a discussion on some of the matters referred to in the "Wrinkle Department," and Editor Thompson is ready to explain anything that may not be understood.

Mr. Clark—I do not understand how the use of rosin or an oil can prevent the splitting of the lead. How does the presence of a little rosin prevent lead from shrinking? Perhaps Mr. Thompson can explain.

Mr. Thompson—My experience with rosin began shortly after Mr. Rice wrote to me last fall of his use of it in Milwaukee. I have had no occasion to pull apart any of the joints in which we have used rosin, and so I cannot corroborate his statement with regard to that, but I have no doubt that it is entirely correct. I have no doubt Mr. Cowdery can give us some information on the matter. I have been using rosin on all the 16 or 12 inch joints which I have had occasion to connect.

Mr. Clark—What does the rosin do? What advantage is there in its use?

Mr. Thompson—I thought that Mr. Rice's description of the matter as printed in the Wrinkle Department was sufficiently plain. He claims it prevents the sudden cooling of the lead by interposing a thin film of rosin between it and the iron of the pipe.

Mr. A. S. Miller—If cooling is prevented, as Mr. Thompson suggests, by the rosin coming in between the lead and the pipe, then we will be in the condition that we were when we used tarred pipe; the rosin will be dissolved by the gas, and we will always have a leaky joint.

Mr. Thompson—I beg Mr. Miller's pardon, but the joint is first yarned. The lead comes in contact with the iron, and the gas is not likely to so thoroughly permeate the yarn as to dissolve all that rosin. In the case of tarred pipe, as I understand it, the gas follows along and dissolves the tar under the hemp. That condition does not obtain in quite the same manner when you use rosin.

Mr. A. S. Miller—Mr. Thompson may be able to make his joint in such a way that the yarn does all the work of holding the gas, but I do not think that that is the common practice. It is true that a joint can be made tight with yarn, but I think in ordinary practice the joint cannot be made so tight with yarn that it will stay tight, and that the lead has to be very largely depended upon to make a tight joint.

The President—Are there any more remarks?

Mr. A. S. Miller—I notice that Mr. Thompson suggests a scheme for keeping his door from burning when he first starts up the fire in the generator. I would suggest that if he simply puts 12, 15 or 18 inches of old ashes and clinker in the bottom of his machine before he starts, he can then fire up at leisure without having any trouble with burning the grates, the doors, or anything of the kind in the bottom part of the machine.

Mr. Clark—I want to emphasize the value of this pressure register of the Altuuria Gas Light Company. In what State was it?

Mr. Thompson—The State of Bliss, I guess.

Mr. Clark—A study of this pressure gauge sheet from day to day, with a thorough knowledge of the condition of the machines, enables a man ultimately to infer from the register the condition of his fire during the time of recording. I believe it to be very valuable indeed. I did not know that it was new. I think Mr. Egner used that in St. Louis a few years ago.

Mr. Thompson—Not to my knowledge, or not in that shape. I would add, however, that Mr. Clark may have had in mind the use of the ordinary exhaust register on a machine which was taking the gas from both the coal plant and the water gas plant, which was operated without a relief holder, so that the runs were really recorded on the gauge. But since coal gas was also used by the same exhauster, no such comparison of results was possible, as is the case where the register is attached directly to the machine. Doubtless that is what suggested to Mr. Egner the trial there.

Mr. Clark—It is certainly a very valuable appliance.

Mr. A. S. Miller—I would like to call attention to this governing device for the blower, and would like to ask Mr. Thompson whether that is for a fan blower or for a direct pressure blower. The fan blowers are usually designed to give a certain pressure, and if the engine is run to speed they will not give that pressure in the neighborhood of the blower, unless the pipe is enormously large, whether the blast is on or off. If the blast pipe is perfectly tight the engine will not require any more power to run it when the machine is shut off, with the gate shut, or with the gate shut and a hole in it, than it would without it, provided only the gas pipe is perfectly tight; and if the blast valves do not hold down they ought to be weighted to hold below the pressure set to run. That being the case I do not see any advantage in having a self-governing device. I think the thing is self-governing by the design of the blower. I think it an unnecessary duplication of machinery.

Mr. Thompson—If Mr. Miller will examine the diagram on Plate 2 he will note quite a difference between the third figure and the fourth figure immediately below it. In the case of the third figure all the valves were shut and the blast gate was open. The engine was taking 16.15 horse power. On the fourth figure the gate was closed, but the 4 inch circular opening was in it to maintain pressure on the pipe. In that case the horse power had been reduced nearly 4.

Mr. A. S. Miller—If I may be allowed to say it, we only need that proof to show that the blast valve was not tight.

Mr. Thompson—That may be: it was one of your machines. (Laughter).

The President—I hope Mr. Clark and Mr. Miller are not the only gentlemen in the room who are qualified to speak of matters in the Wrinkle Department.

Mr. T. D. Miller—Mr. Faben, of Toledo, was just setting up a device of that kind a year ago, and he used a Huntoon governor to regulate the steam. When he had the thing adjusted he found that the opening was not quite large enough, but he expected to receive excellent results from it. He was going to run a new lining, and he had just put in his boilers, and wanted the blower to run all the time. Of course, as soon as he turned the blast into the generator, unless he had some way of regulating the speed of the engine to keep up the pressure, it would reduce it at his blower; and he would not have enough at his generator, either.

The President—If there are no other remarks we will pass to the consideration of other matters.

Mr. A. S. Miller—I move a vote of thanks be tendered to Mr. Thompson for the very efficient work he has done as Editor of the "Wrinkle Department" during the last year. (Carried).

Mr. Thompson—I want to thank the members of the Association for having assisted me so much this year in the collection of items. In no year which preceded this has the correspondence work upon the editor been so little as it has been in the year past. I think a very large portion of that is due to the Secretary for having inserted a notice in our official organ so well in advance of the meeting. A great many contributions came in as the result of that, and as the "Wrinkle Department" has become a little better known to the members, they are, of their own volition, sending in contributions without being asked for them. It has very nearly approached the point I had hoped for some years ago, when the "Wrinkle Department" shall be self-supporting.

Mr. A. S. Miller—I move, as an expression of the unanimous sentiment of the Association, that Mr. Thompson remain the Editor of the "Wrinkle Department" another year.

The President—Mr. Thompson has a standing engagement as Editor of the "Wrinkle Department."

QUESTION BOX.

The President—We will now consider a few questions from the Question Box. They will be read by the Secretary.

"Which do you consider the best form of joint for northern climates - lead or cement?"

The President—Is there any reply to that question?

Mr. Odiorne—Does it mean for coal gas or for natural gas?

The President—If no one feels qualified to answer that question we will pass to the next. That opens up a vast field for discussion, if anybody cares to tackle it. The writer of this question was, perhaps, inexperienced on this point, and would really like the information; and while the subject to most of us is old, hackneyed and worn out, yet I trust that some gentleman will be kind enough, for the sake of the man who has propounded the question, to enlighten him.

Mr. Odiorne—I have always largely used the cement joint in my works. Last spring I laid 1¾ miles of 12 inch and 10 inch pipe, and we used all cement joints, with the exception of one lead joint in each block. Our blocks are about 400 feet long. We have not had a single leak on that line of main. I think in our climate and soil the cement joints are all right.

The President—Do you use Portland cement?

Mr. Odiorne—Portland cement entirely.

The President—What is the proportion of cement to sand?

Mr. Odiorne—We use no sand whatever; it is all cement. We put in a yarn, driving it down tight, then put in the cement, mixed up medium thin (not too stiff), and then put in another yarn and drive it down until the water oozes up through the yarn. Then we make up a thicker cement to finish it with.

Mr. Jenkins—What has the condition of the soil to do with it?

Mr. Odiorne—It may have a good deal to do with it in the way of contraction or expansion. Ours is a clay soil.

Mr. Thompson—I am very much surprised to hear Mr. Odiorne say that he uses neat Portland cement. In our work we have found it desirable to mix our cements, and we found that the finest cement

is by no means the best for that kind of work. The particular mixture we have been using is about half and half of the Portland and a lower grade cement. In another case we used about two-thirds of the lower grade cement and one-third of the higher. In both of these cases the results were very much more satisfactory than were the results obtained with either low grade cement or high grade cement alone.

Mr. Odiorne—I would like to ask Mr. Thompson where he found the difference, and what was the difference in the use of the mixed cement and the pure cement?

Mr. Thompson—One great difference was in the cracking of the cement around the bell. In moulding the fillet between the face of the bell and the body of the pipe with Portland cement, it had a tendency to crack perpendicular to the pipe—that is, away from the face of the bell. With a lower grade of cement it had a slight tendency to crack *around* the pipe. Roughly you could determine somewhat the proportion of mixture by finding the angle at which it cracked.

The President—I would like to ask Mr. Thompson, before he takes his seat, if it has been his practice in St. Louis of late years to lay street mains with cement joints?

Mr. Thompson—Altogether, with the exception of one joint in five or ten, to take care of the expansion and contraction.

A Member—I have been laying the same cement joints for about 20 years. I had found the Rosendale cement, of New York State, a very desirable cement to use. I tried the Portland, and also tried the Louisville, but never got the results that I get with Rosendale cement. I consider that a very good cement for jointing pipes.

Mr. Humphreys—In answering this question we ought to bear in mind the quality of the workmanship employed. One set of cement joints probably would not give any test at all. I have in mind now a little experience which may be of interest. The pipe had been laid for a good many years in a town that I have recently become interested in, but some little leakage was found, and in going over the piping system very carefully the superintendent in charge started out with the idea that he must take out all the cement joints, as he thought that there would probably be found the trouble. We debated the point somewhat. The result so far is that the cement joints are found to be very much more perfect than the lead joints; and there does not begin to be as much leakage from cement joints as from lead joints. That is, too, in a northern country where, because of the very severe winters, the frost goes very deep into the ground. I would not pretend to say that that indicates or is proof that the cement joint is better than the lead joint; but the indication right there is that the man who ran the lead joints did not know as much about his business as the man who made the cement joints. I think we must be very careful how we accept these statements as proofs. Personally, I believe that it is about a toss-up.

Mr. Odiorne—In our works are pipes connected up with the purifying house, where the joints are made with cement, which have been there for 28 years. They are exposed all through the building. They are all perfectly tight. I was warned when we commenced making water gas that the cement joints would not stand the water gas, but I have had no trouble at all, and have found no more leakage with water gas than with coal gas.

The President—Are there any more remarks on this question? If not we will pass to the next.

"Is it policy for a gas company in small cities to do gas fitting and sell gas fixtures?"

Mr. Odiorne—That is a feature we recently took up in our city. Something over a year ago we adopted a plan of putting in services free, thinking we would get a good many new consumers thereby. The gas fitters took advantage of that and put up the price for piping houses 3 cents a foot. Formerly they charged 9 and 12 cents, and now they charge 12 and 15 cents. We concluded that that would not do. We ran a line of mains on which we had a number of subscribers, but when we came to put in the services a number of them objected, saying that they could not afford to have their houses piped. We told them that we would do the piping for them and save them some money. We found that we could do it for about one-half what the gas fitters where charging. From that time on we continued doing it, and we have gained a great many consumers by going to the owners of old dwellings on lines of main, and telling them that we will put in the services, furnish the meter and connections, pipe the houses, and furnish the fixtures, giving either a price for the whole, or allowing them to select the fixtures and pay according to the quality they take. But we give them a price for which we will pipe the house, and it is so much less than they anticipated that we get a great many new consumers.

Mr. T. D. Miller—I suppose as the question refers to small cities it will apply to my place. We are now getting out of the fixture business as fast as we can. It was taken up by the Company because the fitters in the town who were in the business were asking such outrageous prices for their fixtures and piping; but I do not believe that a gas company can afford to merit the antagonism of the local gas fitters. I think they will in the end do the gas company a great deal of harm. While I have been for four years trying right along to get out of the fixture business, I have not yet succeeded. We are attempting only to carry no gas fixtures. We do house piping, and if we cannot do it at prices that will give the fitters a chance to do the work we will do it for less. We think it is an advantage to the Company to be prepared to do that kind of work. But still I would let the fitters understand that we are going to give them a chance. In the electrical business I notice that the supply men work very hard for the electric light company, and every fitter that you can get to do the fitting and to sell the gas fixtures will become a worker for you in the same way. I think a gas company should not go into the business unless the circumstances are very provoking.

Mr. Lynn—I have had little experience with gas fitters and gas fixtures, but I know that gas companies are, as a rule, very particular about anybody who goes into the lighting business in opposition to themselves. They like to have it as much to themselves as they possibly can. Gas fitters as a rule pay licenses to do business and do it at a profit, the same as we manufacture gas. I found this plan to be satisfactory in a small works I am connected with. I went to all the gas fitters in the town and told them we were about to send out solicitors for new consumers, and that we wanted to tell the consumer when we solicited his trade what it would cost him to fit up his house. We said to the gas fitter, "We want you to give us your very lowest figure for running the pipe, and give us your list of pipe from 1 1-4 down to 3-8. We are going to recommend you to fit up the houses." We allow the fitter to do the work because we do not want to antagonize him. It has been frequently said that every gas fitter in the town is a solicitor, either for the gas company or for the electric light company. I got a low figure from the fitters. They had been in the habit of charging 12 and 15 cents, according to size, for running the pipe; and I got it down to 6 1-2 and 9 cents. Now we tell the men just what it will cost them to fit up the house, and then we turn the work over to the fitter who does the Gas Company's work.

Mr. Jenkins—I think that as long as gas fitters do their business properly it is better to let them do the fitting; but when they draw customers away from us—the moment they do as they did with Odiorne, then we ought to jump on them with both feet.

Mr. Copley—I have had some experience in this matter in two different cases. I find that the gas fitters, if properly dealt with, become the most active and the best agents for securing new business that a gas company can have in a small town. This may not apply with equal force to large places; but in a city of 25,000 people, where each man practically knows every other man in the town, each gas fitter has his particular circle of friends—they belong to the same church, or to the same club, or the same lodge, and there is a profit in it for himself, and he can work up more business for the gas company, if he is working in harmony with that company, than can any agent that the gas company can send out to work for itself. That has been my experience. His friends employ him because they believe in him, and accept his word; whereas they take with a grain of allowance anything that the gas company or its agents may tell them. I have been through that in two different places, and have had exactly the same experience in both. If the gas fitters are friendly towards the gas company they go out and bring in consumers. I have followed Mr. Lynn's example for years, and found it worked perfectly satisfactory. We get their lowest prices, and then tell them that we will have to do it ourselves if they do not continue to do it at that price.

"What is the best system of recording location of street mains and services?"

Mr. Jenkins—I asked that question, and am anxious to have some one answer it. I would like to know what is the best method of recording street mains, services, etc., for ordinary size of works?

The President—Perhaps Mr. Thompson can give us some information on that point.

Mr. Thompson—I think a very good method for a large town is to have a set of plat-books, made on a scale of about 100 feet to the inch, and record your lines of main in colors—each color indicating a special size; and with the large pipes shown by double lines joined, so they can be distinguished from the small mains. For showing very large feeders you can use additional lines. In that way a glance at your pipe book will show your range of feeders, and the method by which you can best reinforce pressure at outlying points. I have had in mind for some time a plan which is used by several large companies for recording, on a 50 foot scale, the services and all of the street pipes of the company. It is very much easier to show the location of valves, drips, and connections of all sorts, on a 50 foot scale than it is on a 100 foot scale. I have had some experience as well with the recording of mains in lines of a single color, by a system of dots and dashes. A dotted line would, for instance, indicate a 4 inch main; a dash would indicate a 6 inch main; a dot and dash would indicate an 8 inch main; a double dot and dash would indicate a 10 inch main, and so on. But in my experience it was very much more difficult to know at a glance the location of the larger mains than it was where different colors were employed. In addition to that a field book is used in which are posted the figures turned in by the street foreman, showing in detail, and on a very large scale, all of the cross connections, and all of the specials, and the measurements of depth of pipe, etc. I would have the costs and all of that data also entered in the field book.

Mr. T. D. Miller—Whenever I have anything to say I generally say it, and when I have not, I don't say anything. Mr. Thompson's idea of using a single color suggested itself to me when I went to my present location. I found a map there, made in different colors, to represent different sizes of mains; but either I, or the one who made the map, was color blind, and I could not tell a three inch from a six inch main. So I got up a new set of maps. I adopted a dark blue for my cast iron pipe. There is considerable

wrought iron pipe in the ground in Dallas, and occasionally we put it in now; and so I use a red line for the wrought iron pipe. When wrought iron pipe is replaced by cast iron the blue will go right over it, and it will not show at all. I adopted a single dotted line for a three inch pipe; a double line, one dotted and one line solid, for a four inch; two solid lines for a six inch; two solid lines, with a dotted line in between, for an eight inch; three solid lines for a ten inch; and in that way at a glance, as the pipe enlarges its size the map grows larger, and it makes a design that can be very quickly read simply by looking at it. Then when a man goes to put in services he is given a slip of paper on which is printed the abutting places for two blocks, and along it is a line representing a main, and at each end is another line representing a service; and whichever side that service goes on, he fills in the blank space with the name of the street, and at each end of the block he fills in the depth of the main. Those are filed, and at intervals are put on a map in red ink, with the month and year that the service was laid. I believe that covers all the points I want to know in regard to keeping track of my street mains. It is made on a scale of 100 feet to the inch, and the main is scaled on. Of course it is not very accurate, but it is about as accurate as a man cares to have when he goes to take up a main; it is accurate enough for all practical purposes.

Mr. Shelton—In October, 1885, I read a paper before the American Association on "The Gas Engineer's Pencil," and in one section of that I went into the problem of street lighting to some extent. I think the one who asked this question will find some suggestions there which will be of use to him.

"What success has attended the introduction of Welsbach burners for street lighting during summer months? How are bugs, infinitely small, kept from stopping the flow of gas?"

Mr. Clark—I know of a considerable number of Welsbach lights used as street lights, and there is no difficulty about it at all; the bugs are kept out by small screens. If the bugs are "infinitely" small you must set the screen finer than infinity, I suppose. (Laughter).

Mr. Cowdery—In Milwaukee, when we introduced the Welsbach lamp for street lighting, all we needed was glass at the bottom of the lamp. The bugs would not come in at the top on account of the heat generated by the burner.

"Has the prepayment gas meter been introduced to any general extent, and with what results?"

The President—I think that Mr. McDonald can answer that question.

Mr. McDonald—It is rather a hard question to answer. The prepayment meter is being introduced in quite considerable numbers in some sections of the country. It is being tried by quite a large number of people. I have yet to discover the first person who has used it who failed to soon become a friend of prepayment meters. I might on this occasion say one or two things that my experience has taught me with regard to prepayment meters, and the place for them, which some of you may not have thought of. There are in every town large numbers of people who have possibly, at some time or other, burned gas, but for some cause have ceased to use it, mostly because the bill at the end of a certain month or quarter would be so large that they could not afford to pay it. Also, for the reason that they may have been asked to deposit security for their gas bill and have not been able to do so. I believe that to a large extent the prepayment meter will take the place of the old form of meter with that class of consumers. We place them in houses which have been already piped, and they will consent to have them put there with the understanding that they can put as many coins in the meter as they feel like, and pay only for the gas that they need to use. They need not use it when they do not want to, and they can use it when they do want to. The experience of all who have adopted this course has shown that the people use very much more gas than the companies supposed they would, and, therefore, oftentimes adding quite a valuable consumption to the gas company. The meter is being quite largely used in the city of New York. I think they are more enthusiastic about the use of the prepayment meter than they were when they first started to use them, and are increasingly so all the time. I have been given to understand that they solve some questions in gas consumption in large cities that there did not seem to be any other means of solving.

"Has anyone present used fibre gas pipe?"

Mr. A. S. Miller—I have not used any of it, but as I had a sample sent to me to test, I put it into an atmosphere of gas. That is, I enlarged the office riser which supplies my office with gas, by putting into it a piece of six inch wrought iron pipe, and put a test fibre pipe into it. Three or four weeks later complaint came that we were getting no gas in the office. I investigated the matter and found that the tar had melted on the fibre pipe and that it had run down and stopped up the riser.

Mr. Copley—We have 500 feet of it which we put in last October. It has been in the ground ever since. It has been tested for leaks, but none were found. It has given satisfaction so far, although the cost of it is just about the same as the cost of iron pipe. I put it in more as an experiment, because there may be some places around the gas works where it would be of great use; and I had a very great opportunity to put it in where we could take it out readily and without any inconvenience to ourselves, and so I put it in. As far as we are able to see it gives us good satisfaction.

"Is the Nelson stopper superior to rubber bags in shutting off the flow of gas in street mains?"

Mr. Lynn—I have used the Nelson stopper to some extent in Detroit, not on the artificial gas mains, but on the high pressure natural gas mains. With one exception I have found it to work satisfactorily; and that failure might have been owing to a defect in the stopper, for when I put the stopper in a second time the spring broke. But, testing the Nelson with other stoppers that I have in use, I may say that they have worn very nicely ever since, under 10 pounds of pressure.

The President—Do they require a larger hole to be tapped in the main?

Mr. Lynn—Yes; a little larger hole than when they are used for small pipes; but I think that from 6 inches up it is satisfactory.

Mr. Copley—Does it take long to put it in?

Mr. Lynn—No; it doesn't take any longer to put it in than it does to put it in the bag.

"Should the generator and superheater of a water gas machine be painted red, or white?"

Several Members—It should be painted red.

Mr. Dunbar—That question was asked with a view to ascertain whether there would be more radiation from a superheater or generator painted red than from one painted white.

The President—Will Mr. Humphreys answer that question?

Mr. Humphreys—I would say that that is bringing theory into practice a little too closely. I do not think that it makes any practical difference.

"Can air be drawn or pulled as you would pull a weight by means of an attached cord?"

Mr. Clark—No.

"What is the approximate difference in heat units of a 16 and 20 candle power coal gas?"

The President—That is the last question in the box. If there is no response to it I will call for the reading of the report of the Committee on Final Resolutions.

Report of Committee on Final Resolutions.

Mr. Humphreys read the following report:

Your Committee on Final Resolutions, recognizing the obligations of the Association to those who have contributed so heartily and efficiently to the success of this most successful meeting, beg leave to recommend that the thanks of the Association be extended to the Committee of Arrangements, the Chattanooga Gas Company and its officers, and the Chattanooga Pipe Company, who have so ably co-operated to provide for the comfort and pleasure of our members and the ladies in attendance.

They also recommend that the thanks of the Association be expressed to its officers for their efficient conduct of the affairs of the Association during the year, and for their preparations for and conduct of this meeting.

We recommend that acknowledgments be made to Mr. Gibson for his successful efforts to provide for our entertainment.

A. C. Humphreys,
W. B. Sellers,
I. C. Baxter, } *Committee.*

On motion report and its recommendations were adopted.

The Secretary read the following letter:

Chattanooga, May 20, 1896.

A. W. Littleton, Esq.,
President Western Gas Association.

It may interest your Society to know of a movement on foot looking to the holding of a gas exposition in New York City, during the month of October or November coming. The scheme has not fully crystallized as yet, though it has been very thoroughly discussed by a number of wealthy and influential men largely interested in the gas business, and my co-operation has been sought for.

I have, in pursuance of a general idea, communicated with a few of the leading manufacturers of gas apparatus and appliances, etc., without whose hearty co-operation an undertaking of this character would be impossible. Replies already received are of an exceedingly favorable nature, and it seems highly probable that the project will be carried to a successful issue.

In the event of the holding of such an exposition I believe it would be well that your Association appoint one of its members to represent the Society on the board of direction, and if in your judgment the subject seems worthy of bringing to the attention of the meeting, I should be glad to have you do so.

Respectfully,
E. C. Brown.

The President—I do not know that I thoroughly understand the scheme. Perhaps Mr. Brown can enlighten us a little more than his communication has done; and then it will rest with you to take such action as you see fit.

Mr. Brown—I do not know that I can add anything to what is said in that letter. The scheme is in embryo as yet, and I have so stated in the communication. I think, however, there is very little doubt but that we shall have a gas exposition. I shall be very glad to answer any question that may be put to me, if I am able to do so.

The President—Will it be quite a comprehensive exhibition? And do you think it will last for some little time?

Mr. Brown—Yes. The period of time is now set for about two weeks.

The President—Is it to be strictly a gas exposition?

Mr. Brown—Entirely so.

The President—What is the pleasure of the Association in the matter?

Mr. Jenkins—As I understand it, we shall not have to put any money into it as an Association. I understand that the manufacturers are to pay for it; and you do not ask the Association for any financial aid?

Mr. Brown—No; none whatever.

Mr. Jenkins—That was my understanding of the matter. I think it would be a most valuable thing for the gas companies of this country if such an exhibition were given in New York City. I believe a great many would attend it. The electric light people have just given a magnificent exhibition there; and of course they spent a great deal of money on it. That is one reason why they increase their business as they do. I think this Association can well afford to endorse an exhibit of gas appliances as suggested. I make that as a motion.

The President—Your motion is, as I understand it, that we appoint some member of our Association to represent us. Do we have the privilege of doing that, Mr. Brown?

Mr. Brown—There will be no objection to that.

Mr. Odiorne—I wish to amend Mr. Jenkins' motion, by nominating Mr. Thompson to represent this Association at that exposition. (Applause.)

The President—I think that is a very good suggestion, indeed, as Mr. Thompson is now a resident of New York City, and he will be in very close touch with a great many parties making the exhibit.

Mr. Jenkins—I accept the amendment.

The President—It is moved and seconded that Mr. George T. Thompson be appointed a delegate from this Association, to compose one of the board of control or direction of this proposed exposition enterprise which Mr. Brown has brought to your notice. (Carried.)

The President—One other matter remains for consideration, and it rests with you as to whether you care to consider it or not. Mr. W. W. Goodwin has prepared a contribution, the reading of which will take about ten minutes, in respect to a series of tests he has been making with regard to the efficiency of acetylene as an enricher. If it is your pleasure to listen to Mr. Goodwin for a short time we still have ample time to do so, and I think it will be to most of you quite an interesting paper.

Mr. Clark—I move that Mr. Goodwin be invited to read his paper to the Association. (Carried.) Mr. Goodwin then read the following paper on the

PRACTICAL USE OF ACETYLENE.

Mr. President and Members of the Western Gas Association: As stated in the paper read by me at the meeting of the American Gas Light Association last fall, I had been engaged in making tests in the practical use of acetylene, made from carbide of calcium. Shortly after that meeting the interest in the question of its use as an illuminating agent, *per se*, grew remarkably active, while a general opinion seemed to prevail that it was not available as an enriching agent. This opinion was strengthened by expressions made and published by able authorities. Even at so late a date as April 11, 1896, in an interview with Prof. Vivian B. Lewes, as published in the *Gas World* of that date, the Professor is quoted as making the following statement:

"If you mix acetylene with diluents such as hydrogen, carbon-monoxide, water gas, nitrogen, or carbon dioxide, there is an enormous loss of illuminating power, if the diluent is used in large quantity; but any of these can be used in quantities up to 25 per cent. without seriously affecting the illuminating power. The only advantage would be that it would be easier to get a burner that would consume the gas without smoking. Of the diluents named, hydrogen is the best and carbon dioxide is the worst. But the idea of taking any gas and adding acetylene to it, so as to make a 16 or 20 candle gas, is commercially impracticable, because it would take something like 25 per cent. of acetylene, with even so good a diluent as hydrogen, to give that result."

While I hesitate to cross swords with so good an authority as the Professor, whose hospitality I have had the honor to enjoy, and who, from my personal knowledge, ranks among the ablest men in Europe, in gas matters, yet, at the very date at which this interview took place, I had progressed sufficiently in certain tests I had been engaged in making daily for weeks, to demonstrate that the Professor had made a mistake in his conclusions.

After reading this interview, I invited some gas friends to my old office, where I had erected the apparatus for these tests, and, although these friends were of the Professor's opinion, I made the demonstration and satisfied them that acetylene could be successfully mixed and used with gases composed largely of water gas, greatly improving their illuminating quality. Having accomplished the object of my investigation, I resolved to give to you and my other gas friends the results of these tests. Before being able to make these investigations, I found it was necessary to design and construct a suitable form of apparatus by which, with perfect safety, acetylene could be made and held under pressure, and from which the gas could be drawn and used, *per se*, or for enriching purposes, in any per cent. desired.

After many disheartening efforts and experiments, covering several weeks, I succeeded in constructing a form of apparatus in which the carbide can be placed and kept free from contact with water until the moment at which it is desired to manufacture gas. The manipulation of a peculiar form of valve allows water to reach the carbide, and instantly gas is evolved which is retained within the apparatus, until desired for use. Gauges properly located tell instantly the pressure within the generating chamber, as well as in the outer or water chamber. The highest pressure I have allowed to accumulate in my tests is 30 pounds per square inch. The pressure the machine was adjusted to work under, has been about 10 pounds per square inch, while it has been subjected to 300 pounds hydraulic pressure, and would, beyond doubt, stand hundreds of pounds above this figure. When I constructed it, it was with the supposition of a necessity of subjecting it to at least 200 pounds, but as I progressed with my experiments I found there was no need to go beyond 20 pounds. If I could have had holder capacity to receive the gas as rapidly as I could generate it, there would have been no necessity to have exceeded the pressure to overcome that of the holder.

I placed two small holders alongside the apparatus, connected so that I could use either or both. These were connected to a run of pipes surmounted by a row of burners placed upon burner cocks, the pipe being also connected to the city main as well as to the holder. I also erected a Bunsen photometer in the room, surrounding it with black muslin curtains reaching from ceiling to floor. The meter was adjusted to read from 1-1000 in multiples to 100 cubic feet. This arrangement of the meter enabled the reading of the smallest desirable quantity of gas, per minute observation, viz., 1-1000 of a cubic foot.

The mode of conducting the observations was as follows: The per cent. desired to mix the city gas was first drawn from the generator and allowed to flow into one of the holders, which had been allowed to settle to the bottom of the tank, thereby emptying it; then, the per cent. entering the holder was carefully noted. When the amount determined upon had been admitted, the valve from the generator was closed and the city gas admitted until the whole quantity equaled 100 parts. To be precise, the proportions used in the observations were as follows: If the rate of mixture was to be 4 per cent., the proportions of 39 feet of acetylene were added to 961 feet of city gas, making 1,000 feet, equaling about 4 per cent. of the volume of city gas; if 6 per cent., 57 feet of acetylene were added to 943 feet of city gas; if 8 per cent., 75 feet to 925 feet; if 10 per cent., 90.9 feet to 909.1 feet.

Any of these mixtures having been made, the city gas was tested by the photometer, as well as for its specific gravity, each test consisting of 10 observations made in the usual manner, with the observed candle power corrected to 5 feet after such observations, the mixture was turned on and tested in the same manner for photometric power and specific gravity. After a 4 per cent. mixture was tested, it was followed by tests of 6 per cent., 8 per cent., and 10 per cent. mixtures; all these tests being carefully tabulated and entered into a book of record.

The period covered by the tests I shall submit to you, leaving out hundreds of preliminary observations, made in order to familiarize my assistants with the working of the apparatus, was from April 18, 1896, to May 9, 1896. During this period, 140 observations of city gas, as to its illuminating power and specific gravity, were made, while there were made 130 tests of the 4 per cent. mixture, 120 tests of the 6 per cent. mixture, 130 tests of the 8 per cent. mixture, and 100 tests of the 10 per cent. mixture; or a total of 620 tabulated tests, the records of which are open for the investigation of any one interested. The preliminary tests, made as above noted, and of which no records were kept, exceeded this number.

While I am prepared to give the date and result of each observation, I will not take up time in this manner, but simply give the general average of all these tests, which will enable you to realize what this statement means. The 140 observations of the city gas, made with a Sugg standard burner, with 3 inch flame and 7 inch chimney, corrected to consume 5 feet against 2 candles each consuming at the rate of 120 grains per hour, averaged 16.11 candles. This gas, with a 4 per cent. mixture—*i.e.*, 39 feet $C_2 H_2$ and 961 feet

of the 16.11 candle gas, gave an average of 23.82 candles in 130 observations. With a 6 per cent. mixture, or 57 feet to 943 feet, the average of 120 observations showed 25.99 candles. An 8 per cent. mixture, or 75 feet $C_2 H_2$ with 925 feet city gas, yielded an average of 29 33 candles in 130 observations, while the 10 per cent. mixture, or 90.9 feet $C_2 H_2$ added to 909.1 feet city gas, gave an average of 31.68 candles in 100 observations. The specific gravity for the same number of observations, made either immediately before or immediately after the photometric tests, showed as follows:

140	observations, average	.592,	for city gas.
130	" "	.593,	for 4 per cent. mixture.
120	" "	.613,	for 6 per cent. "
130	" "	.608,	for 8 per cent. "
100	" "	.622,	for 10 per cent "

I also made numerous absorption tests to determine the percentage of $C_2 H_2$, in 100 parts, by volume, by the eudiometer, also with the mixed gases, before and after mixture, but will not enter into details of these tests further than to state that they showed the increase of hydrocarbon. The specific gravity seldom proved to be an indication or test as to the addition of $C_2 H_2$, the reason for this being found in the distribution system of Philadelphia, which frequently involves the necessity of drawing the gas from one end of the city to the other, and then, possibly, back again over the same lines within a few hours. At one time of the day, the gravity would be above .700, then down to below .500, and within a few hours thereafter, .600 or more, depending upon the percentage of coal gas and water gas in the gas mixture at the moment of observation. I am quite confident, however, judging from the specific gravity, that the larger portion of gas that found its way into my testing room was composed of water gas. I also made numerous tests of $C_2 H_2$, *per se*, through burners consuming from 1-2 foot to 1 1-2 feet per hour. When I left to attend this meeting I had just completed an instrument in which I hope, on my return, to be able to determine the explosive force of $C_2 H_2$, and its adaptability for gas engines.

In conclusion, I submit the following for consideration and reflection as to the value of $C_2 H_2$ as an enricher, over naphtha or oil. We all know the number of gallons required to produce the illuminating power I have named as resulting in the tests submitted.

It will be remembered that I stated, with an average of 16.11 candles in 140 tests, the addition of 4 per cent. of $C_2 H_2$ to this raised it to an average of 23.32 candles, in 130 tests; an increase of 7.21 candles, equal to 44.75 per cent., or 11.19 per cent. for each one per cent. of $C_2 H_2$.

The 6 per cent. mixture raised the same gas to an average of 25.99 candles, equal to 9.83 candles, in a series of 120 tests; a gain of 61.32 per cent., or 10.22 per cent. for each one per cent. of $C_2 H_2$.

The 8 per cent. mixture raised the same gas to an average of 29.33 candles, equal to a gain of 13.22 candles, or 82.25 per cent., or 10.25 per cent. in a series of 130 tests for each one per cent. of $C_2 H_2$.

The 10 per cent. mixture, in an average of 100 tests, raised the same gas to 31.68 candles, a gain of 15.57 candles; total average of of 96.66 per cent. or 9.68 per cent. for each one per cent of $C_2 H_2$.

My conclusions are that a mixture of 4 per cent. with a 15 candle gas is ample, and would give a gas for diffusive illuminating power superior to any 20 candle electric light. The gas seems to have a penetrating power superior to ordinary water or coal gas.

I believe it safe to calculate that one pound of carbide will produce sufficient $C_2 H_2$ to increase the illuminating power of 1000 cubic feet of 15 candle gas fully 5 per cent. If carbide can be produced at $20 per ton, it means a cost of one cent per each 5 per cent. of illuminating power added to each 1000 cubic feet of 15 candle gas; which means say 8 cents to raise 1000 cubic feet of 15 candle gas to 21 candle gas. From this data, we can make any calculation for cost of candle power, with carbide at $20, $30, or $40 per ton, as against naphtha, crude oil, etc., although recent developments have determined beyond question that carbide can be manufactured for considerably less than the rate first named.

Now, gentlemen, thanking you for the kind attention you have given me, I can only hope that the time occupied will prove to have been the means of giving you some information upon this important subject that will repay you.

Discussion.

Mr. President—Mr. Goodwin's paper is before you for discussion.

Mr. Humphreys—The members need not get worried as I am not going to say anything about diffusion. I would like to point out—although no doubt Mr. Goodwin has thought of it, and can perhaps make some future calculations—that in making the comparison between enrichment with acetylene and enrichment with any other material, it must be borne in mind that the results obtained in raising gas from, say 16 candle power, to 24 candle power, are very different from the results obtained in raising it from 0 to 16 candle power. In other words it would not be fair to compare the quantity of acetylene required to raise the candle power from 18 to 24, with the quantity of oil required to raise water gas from 0 to 18, and then assume that because you found you had got your result with less than one-third of the cost of the use of oil, that you were getting a better financial result. In other words, if Mr. Goodwin will go over his work again, and will get unenriched or blue water gas, and then make his comparison between the amount of acetylene used from 24 candle power to 0, and will compare that with the amount of oil required at prevailing prices, or even at the cost of acetylene as given by him now, I think the results stated by him will be modified. We know perfectly well that we can get a certain result in water gas manufacture, up to say 16 and 18 candle power, but that when we go higher it does not begin to require the same amount of oil in proportion to give the additional candle power that we are aiming for. That must not be lost sight of for the moment. I speak of it because in some recent figures given with respect to another method of enrichment we absolutely lost sight of that point—which is a most important one. I would like to ask Mr. Goodwin if he can give us any fair idea of the range of difference from his experiments, supposing there was a certain percentage of increase of candle power, and a certain amount of acetylene required; about what was the range of difference in the actual observations. Let us see about how it runs in uniformity of result.

Mr. Goodwin—I have in my room a diagram which was completed about an hour before I left, and which will answer your question a great deal better than I can undertake to do it now. I will be pleased to show it. Or, if I can get it from my room, I will show it now. That diagram shows the whole range, and it is just exactly an answer to the question asked. I wish you to understand that I have nothing to conceal, and that I have no personal interest in this thing. I want simply, as a gas man, to give you the benefit of the information that I have acquired.

Mr. Jenkins—I would like to ask Mr. Goodwin whether he thinks this would hold good five miles away from the gas works?

Mr. Goodwin—From all my observations I would say that it would. Within the next three weeks, if any one will come to my office, I will let him take charge of the apparatus and make any experiments he pleases to satisfy himself as to the accuracy of my statements.

Mr. T. D. Miller—I would like to ask Mr. Goodwin how long this mixture of city gas and acetylene was allowed to remain before the test was made?

Mr. Goodwin—Sometimes for half a week, and some tests were made immediately.

Mr. T. D. Miller—Was there any difference in the result when this mixture remained for a long time?

Mr. Goodwin—None whatever that I could discover. In reply to the point made by Mr. Humphreys I will say that I recognize the force of it, and I have tried my very best to get a bag of blue gas, but did not succeed. The day before I left home I was told that at a certain place within ten miles from Philadelphia I could have all the blue gas I wanted. It may be possible that I will go there and carry on my experiments. But the fact is that what I wished to determine was the question whether it could be mixed with water gas or coal gas; and as Prof. Lewes, who is, as you know, a very positive man, said that it could not be done, I was in the act of making the test when I made this statement.

On motion the thanks of the Association were tendered to Mr. Goodwin for his paper.

The President—Before adjourning I would like to say that in order to make the proposed amendment to our Constitution it will be necessary to have that amendment offered at this meeting, otherwise it will go over and be presented at our next meeting, and then a year will have to elapse before it can be considered. Have you the amendment prepared?

Mr. Jenkins—I have only thought of it since the President referred to it in his address.

The President—The Committee on the President's Address recommended that such an amendment to the Constitution be made in due time. If some one can offer the amendment verbally it will be considered as presented at this meeting and then it can be acted upon at the next. I am sorry it was not thought of sooner, because it ought to be very carefully worded.

When the report of the Committee on the next place of meeting was presented Gen. Hickenlooper was not in the room. It may have been that if he had been here he would have fought that report and combated it all he knew how; and we all know that he is a good fighter. As I see that the General is now present we would like to have him tell us whether it is agreeable to him to have us meet in Cincinnati next year?

Gen. Hickenlooper—It is not only entirely agreeable to me but I am very much gratified at your selection. I can say for the Company I represent, and for myself and associates, that it will afford us all a great deal of personal satisfaction and official pleasure to have this Association as our guests next year. (Applause).

The President—If Mr. Chollar has that amendment prepared and will present it—

Mr. Clark—Would it not be better to have the matter go over for another year, rather than recommend an amendment to the Constitution which may now be written in such great haste?

The President—Perhaps it would be.

Mr. Jenkins—I was going to make the suggestion that the original resolution offered here to-day could be amended before voting upon it, and it would not have to lie over for another year. If we offer the resolution here to-day, before we adopt it, we could make slight amendments in it.

Mr. Clark—It would have to go over for another year, I think.

The President—Yes; according to our Constitution,

The Association then adjourned.

[Official Report—Revised by the Secretary.—Continued from page 816.]

SECOND ANNUAL MEETING OF THE TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

Held at the Oriental Hotel, Dallas, Texas, May 12 and 13.

First Day—Morning Session.

Mr. W. A. McGoldrick, Supt. of the San Antonio Gas Company, read a paper on

ONE YEAR'S EXPERIENCE WITH GAS IN THE METROPOLIS OF TEXAS.

When I first came to San Antonio, and had the pleasure of taking charge of the gas department of the San Antonio Gas Company, I made a thorough canvass of the city.

The first thing I noticed was that a great many of the meters set failed to show any use of gas; these meters were only to be used when the electric light was out. Our electric station is better managed than any other station I know of; and this is saying a great deal. There are three 500-horse power engines side by side; one runs in day time and two at night. This shows we are well prepared as to power. I will not go into detail, as there would be too much to explain, although to explain how well the electric department is managed, I will say, consumers would rather take electric light from the San Antonio Gas Company at a higher rate, than from the San Antonio Electric Company at a lower rate. The cause of this is the service they get from our Company. So you see I am placed in a difficult position, to fight our own Company, and such a service as it gives. Besides the excellent service the electric department gives, there are over 100 electric workers in San Antonio, and they all push their business to perfection.

I made a thorough canvass, and found that a great many improvements could be made.

First, I located all my drips, pumped them out and got them in good shape; second, I put my governor in smooth working order, so as to give the gas a proper pressure; third, I cleaned out the pipes of our consumers gratis; fourth, I placed the fixtures in as good shape as possible, cleaned out all the tips and made "fishtails" scarce, using the Welsbach light; fifth, I took as many traps out of service pipes and mains as I could conveniently get at. Two of the best consumers I now have were gained this way; sixth, and the main thing, I ran up the candle power as much as possible and held it uniform.

Now for the old reliable Welsbach light. I found this light the worst abused light ever used by a gas consumer. It was handled first here by a man whose sole aim was just to get rid of them. He flooded the town with them, and then sold the agency to a plumbing house, that had no time to work up the business, as they give the most of their time to electric lighting. Every one who had bought the lamp had discarded it, and most of them threw them away altogether, pronouncing them the biggest nuisance they had ever encountered. I could state several reasons for this trouble; but I will not as all gas men know what causes the Welsbach light to give dissatisfaction, and the Welsbach people know the gas companies could kill these lights in a week's time. I had a hard task before me in getting the people to take these lights back. I was told by old lighting men of the city not to try, as it was useless. I started on one consumer, who said if the Gas Company would make him a present of these lights he would not use them, but in one month I had 20 lights in his place of business, and he is still well satisfied with them, having used them all last summer, with 6 fans running at full speed.

My plan of looking after the Welsbach light is to see that a consumer's service, house pipe and fixtures are all right; place the light on, and see that the mantle is perfectly white all the way up, that is, with the air valve wide open, being sure I have the proper pressure. I find the lights give better satisfaction by giving them all the air possible to make a perfectly blue flame. The mantles last longer, never burning black at the top. I make a round-up in all places once a week where a consumer uses more than four lights, and I am at all times at the service of my consumers (24 hours a day), and it gives me pleasure to keep their lights in trim. As one of the best consumers I have—he uses 41 Welsbach lights twelve hours a night—remarked to an electric man who delights in placing fans as close to Welsbach lights as possible and giving them all the speed possible, etc., "I am well satisfied with my light, even if I pay for a few extra mantles, as I get one trimmed any time of night that I call up Mr. McGoldrick; and this is why I like them, for I am never in the dark." I find it no trouble at all to look after my consumers personally, in fact it is a pleasure, and it pleases them, and I gain many friends. I never sell a mantle in the office, as it causes dissatisfaction. I find it is much better to put them on myself, and then there is no kick to be made about the mantles breaking, etc. We have only one price for mantles, which price is 60 cents, and we see to it that all mantles are perfect. When one splits or breaks at the top, as often is the case when they are burnt off, I replace it at once with a good one.

I recommend mica chimneys, but I notice most of the gas men say, "Glass will do." Just as soon as fans are put up, my experience is the glass begins to break, and it is not only the breaking of the glass, but a consumer swears his business is going to destruction, for, with one or two glass chimneys broken, there are some superstitious people who think even a glass chimney breaking is bad luck. If I can get my consumers to buy mica chimneys I do so, as a mica chimney lasts six months to one year, and in very nearly every case they save one or two mantles.

I also found some of our meters in very bad shape. We use all dry meters, and it was necessary to give them my personal attention to insure good results. I found several meters set too near stoves, the heat therefrom causing the diaphragm to dry up to a crisp. This should always be avoided, and meters set in a temperature as near 60° as possible. I also found meters resting on the ground, with their bottoms rotted out; this should be avoided. I repair all my meters, that is, with the help of my fitters (although I give them my personal attention), and then I am always sure my meters are right. This is the most particular part of the gas selling business. You all know the tale of a merchant selling goods on broken scales.

I am doing all I can to work up our fuel business in San Antonio. I could do a great deal of this business if our mains reached people who would use gas for cooking, but as it is we are on the streets where people are able to have two or three servants, but are not able, as they claim, to pay for their servants' extragavance. I went to all our consumers using gas stoves, and got a testimonial, all claiming that they would not be without gas, and that it was cheaper than wood or coal, but still they don't use as much as I would wish them to. I have just run two blocks of mains to get four stove consumers. One of my best gas customers remarked: "Now that I have a gas stove, I can use my dining room girl for a nurse, for my cook has plenty of time to do all the work. Cooking by gas is so much quicker and handier."

I would like the members to discuss this matter especially, thereby giving all the benefit of each one's experience in selling fuel gas.

Discussion.

Mr. Cullinane—The matter of Welsbach lamps interests everybody in the gas business. I learn that the Welsbach people charge one price at one place and another price at another place.

Mr. McGoldrick—I do not think such is the case, but the talk is brought about by the consumers. The Company I represent in San Antonio is the exclusive agent there for the Welsbach burner, but we allow plumbers and gasfitters in the town to handle the lamps. We give them a fixed price at which they must be sold, which price is the one fixed by the Welsbach people. I think, however, that these plumbers and fitters in making bids on work, in some instances, in order to induce a man to give them a contract, put on Welsbach lamps, making concessions in the price of the whole job. I am satisfied that the parent company has only one price.

Mr. Bauer—At Texarkana I signed a contract with the Welsbach people to sell lamps for $2.50 apiece, and 50 cents apiece for mantles.

The Chair—Do you live in Texas or Arkansas?

Mr. Bauer—I live in Arkansas, but do business in Texas.

Mr. Fitzgerald—Referring to the chimneys used in connection with the Welsbach light I do not find that the mica chimneys give the satisfaction that they were expected to give in the beginning. They very soon become discolored and often scale on the inside. It is very hard to clean them and they can never be made to look like new again after they become partly discolored. We employ a man to look after the lights and keep the chimneys cleaned, replace broken chimneys and mantles, and when he sees anything out of order he calls the consumer's attention to it and attends to keeping the lamp in order, charging for the renewals, but making no charge for his attention.

Mr. McGoldrick—There are several kinds of mica chimneys in use. We are using a one-ply chimney, purchased in New York, with a little canopy over the top, and we have very little trouble with them: we clean them with tissue paper.

The Chair—Are you aware of the fact that the five-inch mica chimney with the canopy reduces your candle power below that which you would get with the 7-inch chimney without the canopy?

Mr. McGoldrick—Yes, sir; I have noticed the reduction in candle power, but that does not make any difference, as there is plenty of light anyhow. We are furnishing several large consumers with Welsbach lights who formerly used electricity, and they are much pleased with the light and favor the mica chimney.

The Chair—Our experience wfth the Welsbach light in Dallas has been satisfactory, and everyone who exercises any care at all in its use is well pleased with it. Coal oil is no longer economical as compared with the Welsbach light, considering the cost of oil, chimneys and wicks to produce the same amount of light. The frail character of the mantle is the only objection I ever hear to the light, but the Welsbach Company is working to improve this defect. Last year in New York I saw the Crawford burner on exhibition; the mantle was very heavy and quite substantial. It required about ten seconds to become incandescent, and took about the same length of time to cool off after the gas was turned off. I believe the inventive genius of the people employed by the Welsbach Company will discover eventually a method of making mantles that will be more substantial. The advance in the efficiency of burners has been something wonderful in the 13 years I have been in the gas business. The Sugg "standard D burner" was an improvement over the C burner, and gave an efficiency of about 3½ candles to the foot. Then the Lungren and similar regenerative burners came out and gave 10 candles to the foot. Now we have the Welsbach giving 20 candles to the foot, with say 17 or 18 candle gas.

Mr. McGoldrick—The Lungren lamps came in very handy with the prepayment meters. We have one in a restaurant in San Antonio which formerly used coal oil. I put in one with a prepayment meter, and now we are getting an average of about $12 a month there, where formerly we got nothing.

Mr. Judge—A party in Tyler is using the Welsbach lamp with gasoline machine gas, but the breakage of mantles seems to be heavy with that kind of gas. He claims, however, that he can return the broken mantles to the Company and receive pay for them. Is that a fact?

The Chair—The Welsbach people will pay for all mantle dust returned to them in good condition; they will also allow something for the wires with the platinum attached.

Mr. Monroe—I would like to ask the Chairman what the average life of the Welsbach mantle is?

The Chair—The average life of the mantle is fully 1,000 hours. We had a mantle in Dallas that had been used every night until 11 or 12 o'clock for three years, and it was giving a good light at the expiration of that time. I have not seen it lately and do not know whether it is still in use or not. We had another one in the counting room of a wholesale house that was burned all day for the bookkeeper to work by and was burned all night to light the safe; it was in constant use for 10 months, and was giving a fair light at the expiration of that time—somewhere in the neighborhood of 18 or 20 candles.

Mr. McGoldrick—My experience is that the average life of mantles is about 1,000 hours.

There being no further discussion, a vote of thanks was extended to Mr. McGoldrick for his paper.

Some Routine Business.

Mr. Fitzgerald—It is a matter of regret to the Association that our President, Mr. Holmes, is not here to attend this meeting. I believe it is more to his exertions and the enthusiasm that he aroused than to any other thing that brought this Association into existence. He has been an enthusiastic worker for it all the time, and has done a great deal to promote its welfare and to secure members. I think it would be appropriate for the Association to express its regret at his inability to be here, owing to the fact that his absence is due to sickness, and I move that this sentiment be embodied in a motion. The motion was unanimously carried.

On motion a committee of three was appointed to draw up resolutions of respect upon the death of Mr. W. T. M. Mottram, a member of the Association, and the Chair appointed Messrs. Monroe, Brooke and Oliger as such committee.

The Secretary then read a congratulatory telegram from the American Gas Light Journal, following which a recess was ordered.

(To be Continued.)

An additional lift is being put on the storage holder of the gas works station at Wistar street and the Reading Railroad depot, Germantown, Pa. This change will increase the storage facilities from 390,000 cubic feet to 540,000 cubic feet. It is thought the addition will be completed by August 1st.

SPECIAL ENGLISH CORRESPONDENCE.

Communicated by Norton H. Humphrys.

Salisbury, England, May 9th, 1896.

The Spring Meetings.—A Wrinkle.—The Welsbach Burner in the Law Courts.—A Self-Lighting Gas Burner—A Uniform Temperature Meter.

About the end of April is the time of year when gas managers come out of their shells after their winter's work, and the technical press becomes redolent of inaugural addresses, papers, discussions, visits to works, and the other details which go to make up the proceedings of what you call a "State," and we a "District" Gas Managers' Association. Following the usual custom, the meetings of the Eastern Counties, the Southwest and the North of England, have just been held, while the Southern District is yet in the near future. But so far as we have gone, the matter presented for consideration is decidedly above the average, both in respect to novelty and originality of treatment, and goes a long way towards showing that gas engineers, so far from getting pumped out by periodical meetings, become enlivened and capable of yielding increased supplies. If we take a few recent papers at haphazard, and compare them with similar productions of 25 or 30 years ago, we shall see that with increased intercourse there has come improved knowledge and ability to arrange and put our ideas on paper in regular form. At the Eastern meeting, Mr. Troughton discoursed on gas versus electricity as an investment for municipal authorities, and in so doing brought out the reliable character of the gas industry as compared with the eccentricity of its brilliant rival. But I am one of those who think that municipal authorities should leave investments of any kind to private enterprise. This is the field to which they legitimately belong, and there are few locations that would not be better served by the efforts of private enterprise than by local authorities, who should be able to find better uses for their abilities than competing with private trade. Then, at the Northern's gathering, we have Mr. J. H. Penney—evidently a believer in the proverb "take care of the *Penney* and the pound will take care of itself"—treating on the everyday but oft neglected subject of how to minimize bad debts.

The economies of scientific working and modern appliances are of no avail if they are not followed up by accurate office work and diligent collecting, and a very common mistake to which municipal owners are particularly liable, is to cut down the cost of office work and collection to the lowest possible figure. A person who has failed at everything else, and is therefore only too thankful to write out the gas bills or collect the amounts due, at a starvation price, is by no means the best qualified for a seat in the office or a billet as collector, nor is a "salary" that does not equal a fair day's wage likely to lead to that courtesy and tact in dealing with the customers, to say nothing of push in extending the use of gas, which all agree is such a very necessary thing at the present time. The features of the Southwest were a scholarly dissertation on the production of steam and power, a matter that acquires greater importance with the introduction of water gas, by Mr. W. Stagg, which was followed by some interesting examples of the adaptation of incandescent gas lighting to the illumination of large spaces and workshops, described by Mr. Riley. As the gas engineer of one of our chief railway companies, Mr. Riley had a wide scope for the exercise of his abilities, and he is applying the incandescent light, in clusters ranging up to 15 burners in each, with very satisfactory results.

I notice that the "Wrinkle Department" is becoming quite a feature at meetings of American Gas Managers. Perhaps my attention is the more particularly directed to it because the gentleman who appears to be the originator of the movement, Mr. George T. Thompson, is one of the few—far too few—American friends who have hunted up your English Correspondent on his native soil. However that may be, I will take the opportunity to add a hint to that department that is worth the attention of practical men who find their fingers all thumbs when dealing with delicate laboratory apparatus, and yet like to know as much as possible about the substances with which they have to deal. It is a method of taking specific gravities with simple and inexpensive apparatus. Get a pair of ordinary shop balances with a set of weights ranging from 2 pounds to one-eighth ounce. Also a few ordinary glass flasks, gauged to contain 16 fluid ounces (7,000 grains) by a ring scratched round the neck, and a tall, narrow glass cylinder measure, graduated into one-hundreths—say 10,000 fluid grains in 100 parts. Any dealer in chemical apparatus will supply these. To take the specific gravity of a liquid: Take one of the flasks, make it quite clean and dry, and counterbalance it on the scales. A small tin box, into which sand or shot is poured till the desired result is obtained, makes a

convenient counterbalance. Fill the flask up to the mark, taking care that the concave curve formed by the surface of the liquid is just above the scratch, which must just correspond with the *lower edge*, when held level with the eye. Ascertain the weight of the liquid, and this result stated in pounds represents the specific gravity. For example, a specimen of ammoniacal liquor, weighing 1 lb. ¼ oz., would have a specific gravity of $1\frac{1}{16} = 1.015$, and a sample of oil of vitriol weighing 1 lb. 11 ozs., would have a specific gravity of 1.682. This arrangement was originally set out as a workman's test of the quality of oil of vitriol as delivered for sulphate making, but has proved applicable to many other purposes. Since it has been pointed out that the specific gravity test is useless as an indication of the commercial value of an ammoniacal liquor, there is a tendency to disregard it altogether, and to overlook the fact that for rapid approximate tests of day to day working, dealing with liquors produced from a regular quality of coal in one special way, it is capable of yielding good service. If preferred, instead of using a fixed measure and changeable weights, a fixed weight and variable quantity of liquid can be used. In this case the cylinder measure is counterbalanced, and the liquid to be tested is poured in slowly, a few drops at a time, until the weight selected is counterbalanced (I am assuming that flat balances with the lever below the pans are used, and not scales with suspended pans.) This method is useful for the guidance of a workman who has to make up a fixed specific gravity of liquid. Solids that are not acted upon by water are dealt with as follows: Select pieces that will easily slide into the cylinder and carefully weigh them. Fill the cylinder up to a convenient mark, say half way, with water. Carefully introduce the weighed samples and note the displacement. If we take ¾ lb. of coal (5,250 grains), and the water level rises from 5,000 up to 9,300 when it is immersed, then the 5,250 grains of coal have displaced 4,300 grains of water, and the specific gravity is $5,250 \div 4,300 = 1.218$. If the solid is in the form of powder it should be briskly shaken in the liquid to displace adhering air.

The incandescent gas burner has lately been a prominent object in the London law courts. The awe-striking threats that have for some time been a feature of the advertising columns of our technical journals, warning all and sundry against the direful consequences that would follow any attempt to use the mantle in conjunction with any device other than the burner sold by the makers, and the more or less defiant counterblast that these threats have called forth, which have furnished a lively variety to monotonous accounts of meetings of gas companies and gas engineers' associations, have culminated in a kind of legal pitched battle, with a vast array of legal and scientific talent on each side. Apart from the issues at stake, this has had the result of bringing out a great amount of valuable information on the subject of incandescent gas lighting, as the reports of the proceedings furnish a complete summary of the present state of our knowledge on the subject. All who wish for information as to the materials used, the minerals from which they are obtained, the processes incidental to the manufacture of the mantle, and so forth, will find such in the evidence, which goes further than many law cases, and includes, in addition to the usual statements of counsel and evidence of experts, descriptions of numerous experiments which were actually performed in court. The Incandescent Gas Light Company have every reason to be satisfied with the result, as the validity of their patents was fully maintained, and the manner in which these documents went through the severe overhauling to which they were subjected proves them to have been cleverly drafted in the first place. But the decisions are not yet final, as there is some talk of appeals. The editor of the *Gas World* has published a reprint of this report in pamphlet form.

A self-lighting gas burner has just been placed upon the market, and this is a new improvement that should receive every encouragement from gas engineers. Electricians do not forget to elaborate the trouble of igniting the gas jet, the risk of fire or of tumbling off the chair or ladder, etc., as compared with the case of simply turning the button of the electric switch, and this appliance, if successful, secures all the benefit afforded by the electric light in this respect for the much abused gas. The utility of the invention is illustrated by some clever sketches, one of which shows the alarm experienced by a burglar when the scene of his operations is suddenly illuminated by the suspicious householder who, concealed by the open door, has been able to reach the button close by. In another sketch a liveried footman, much too dignified to perform such a menial operation as striking a match, is manipulating the lighting of a large apartment, without interfering with the occupations of the inmates. The appliance is *bona fide* self-lighting, and not merely an adaptation of a pilot jet arrangement, and there are no mechanical parts.

Another important invention that is just being introduced is Fiddes & Cowan's uniform temperature meter. According to the claim of the patentees, this meter is intended to automatically correct its indications for any variations from the standard temperature, so that whatever be the temperature at which the gas is measured the consumer will be supplied with a uniform weight of gas for every cubic foot registered against him. The invention can be applied to wet or dry meters of any size and to works' station meters, and the principle is to alter the area of the measuring chambers, which is done by a pin working in a slot on the crank of the dry meter, and by a movable overflow tube in the case of the wet meter, the automatic actuating device being similar in each case. This consists of a tube bent into a circular form, made of any suitable material that is sensitive to variations of temperature, and preferably filled with a fluid under pressure. One end is held fast and the other is free to move, and actuates the adjusting machinery. If this machine turns out a practical success it will prove of great advantage. If it is agreed to sell gas throughout a country at a standard temperature; all risk of variations on account of temperature will be done away with, and a common ground for comparison obtained. It will do away with the vexed question of the effect of temperature, as registered at the works' meter and at the consumers' meter respectively, upon the leakage. But I do not gather that it touches the variations due to barometrical pressure, which really affect the uniformity of the actual weight of gas supplied for a cubic foot, to a much greater extent than the changes in volume due to variations of temperature.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Redwing (Minn.) Gas and Electric Company have determined to expend $25,000 in improving the condition of the gas division of that enterprise. We understand that the contracts for the betterments have been awarded, but we are unable to report the names of the successful bidders, save in respect of the construction of the buildings proper, which are to be erected by Mr. David Douglas, of Eau Claire, Wis.

MR. WILLIAM BARRET RIDGELY has been elected President of the Springfield (Ills.) Gas Light Company, vice Mr. William Ridgely, who withdraws from active business on account of illness.

THE Hon. Francis A. Hobart has filed a protest with the Massachusetts Board of Gas and Electric Light Commissioners, in which he asks the Board to restrain the authorities of Braintree from supplying incandescent electric lights, for domestic use, at a lamp price per hour which caused the town a loss in the last twelvemonth of $1,100.

MR. LEANDER CHURCH has been elected Secretary of the City of Flint (Mich.) Gas Light Company, vice Mr. G. L. Denham, resigned.

THE proprietors of the Chelsea (Mass.) Gas Light Company have petitioned the Board of Gas and Electric Light Commissioners for permission to increase the bonded indebtedness of the concern to $150,000, from $100,000.

A CORRESPONDENT at East Boston, Mass., writing under date of the 22d May, says: "On the 15th inst. an explosion of gasoline took place on the works of the Standard Oil Company, which demolished one side of the building and set fire to the sheds of the East Boston Gas Company. Before the flames were extinguished the Gas Company sheds were totally destroyed, and the wharf was also badly damaged. The coal on storage at the time amounted to 900 tons. At the time of the explosion the schooner Rebecca Sheppard was making fast to the wharf, and she narrowly escaped destruction. A tugboat towed her out of the danger line, but not before her sails were somewhat scorched. The Sheppard had on board 623 tons of Monongahela coal, consigned to the Gas Company."

THE East Boston Gas Company, we might also say, is constructing a tank in which is to rest a storage holder rated to contain 250,000 cubic feet.

THE following is the text of a circular recently issued to the housekeepers of Oakland, Cal., over the signature of Mr. John A. Britton, Secretary of the Oakland Gas, Light and Heat Company: "We want to interest you in the matter of gas stoves. We can sell you a stove, which will do all your cooking, for a less sum than you can buy either a wood or a coal stove; and the price of gas will make it cost you less than any other fuel you can buy. You must have heard of the stoves from your neighbors, for more than 1,000 are in use in this territory. They roast, boil and fry. They don't heat the kitchen. They are

clean; have no ashes. If you use 1,000 cubic feet a month you get gas at $1.75 per 1,000. The stove we sell for $12 is placed in your house, and you are instructed in its care and management. It doesn't cost you anything for all time to keep it in repair and condition, as we do that for you free of expense. Our agent will be in attendance at the office, corner of Railroad avenue and Park street, between four and five o'clock daily, to exhibit the stoves. We trust that you will find time to call and investigate the conveniences and advantages of the same."

THE authorities of the outlying town of St. Joseph, Mich., have authorized the proprietors of the Excelsior Gas Company, of Benton Harbor, to extend their pipes to St. Joseph. The Excelsior folks agree to supply gas in St. Joseph at a rate not to exceed $1.60 per 1,000 cubic feet. The contract for the laying of the necessary pipe was awarded to Mr. I. W. Newcomer, of Chicago.

MR. WM. ANDERSON, Supt. of the East Boston (Mass.) Gas Company, informs us that the Anderson main pipe cutter is in good demand. Recent shipments include a No. 1 instrument to the Ann Arbor (Mich.) Gas Company, and a No. 2 to the Northern Gas Light Company, of this city. Over 60 of the Anderson cutters are now in use.

THE annual election of the Ottawa (Can.) Gas Company resulted in the following choice for officers: Directors, John Coates, Francis Clemow, John Manuel and Alexander Ferguson; President, John Coates; Vice President, Francis Clemow; Secy. and Treas., Geo. P. Spittal. The report submitted by the Board of Directors is appended: "Your Directors, in presenting the annual report of the Company, for the year ending March 31st, 1896, have pleasure in submitting for your consideration, statement of assets and liabilities and of revenue and expenditure accounts, which shows that the business for the year has been exceedingly good. There has been an increase of over 4 millions cubic feet in the quantity of gas sold as compared with the preceding year, mainly attributable to the longer session of Parliament, and the introduction of the Auer incandescent gas burners, which are becoming very popular. The profit for the year ending 31st March, 1895, was $22,785.61, and for the year ending 31st March, 1896, was $26,140.45, which shows an actual increase of profit amounting to $3,354.84; and after deducting the interest on bonds, leaves a net profit of $23,098.78, out of which 7 per cent. (amounting to $19,048.40) will be available for distribution among the shareholders, and the remainder ($4,050.38) set aside for reserve. Out of the balance to the credit of profit and loss your Directors have deemed it advisable to create a reserve fund of $7,552.28, which includes the net premium on total issue of bonds; and to write off $16,300.44 for depreciation of plant, mains, etc., also providing sufficiently for bad debts. Improvements at the works and on the mains continue to be made from time to time, and the results obtained during the past year have been the best yet secured. After an experience of 15 months your Directors are pleased to report that the new purifiers have fulfilled their highest expectations in the saving of labor and time. Owing to the large increase in consumption, the prospect of another early session of Parliament, and the insecurity of one of the present holders, your Directors have been compelled to provide for additional storage capacity with all possible speed, and it is expected that the tank and building now in course of construction, together with the new gasholder. which will be telescopic and having a capacity of 200,000 cubic feet, will be completed by the end of August. The works will then be fully equipped, and in first-class condition for meeting all such demands as we recently experienced, when we had to send out occasionally 240,000, with a storage capacity of 120,000 cubic feet only. The price of coal has been slightly lower, and gas oil much higher during the latter part of the financial year, which has somewhat interfered with our profits, but it is hoped that the oil increase is only temporary, otherwise we may have to set the retorts in order, and revert back to the former system of manufacture. During the year the City Council decided to asphalt three of the principal streets—viz., Sparks, Rideau and Banks—and requested the Company to take advantage of the opportunity so as not to disturb the pavement in the near future; consequently, services were laid across the streets to every house and store, which will save the Company a great deal of expense in the future. In order to meet the necessary expenses already referred to, and to provide for extensions to the Glebe, Suburb, Concession street, and services in other streets to be asphalted the coming summer—your Directors have placed additional bonds at 5 per cent. premium, and have decided, with your approval, to issue new stock, as occasion may require, to consumers and friends who may be of service to the Company, in order to make up the balance required to complete the extensions. The illuminating power of the gas has been kept up to 22, which is equal to the highest in Canada. The leakage on the mains has again been considerably reduced this year, and it is hoped this season will see it below the average Canadian level. Since last report 131 meters have been put in to new consumers, making a total of 692 lighting and 520 fuel. Your Directors have reason to approve of the continued careful and judicious management of all the officials of the Company, who deserve great praise for the excellent way they have discharged their duties."

THE real property owned by the San Francisco Gas Light Company, not necessary for its purpose, was sold at auction on the 19th of May, by Messrs. Eaton, Eldridge & Co. The property sold included some valuable frontage on First, Fremont, Beale, Howard and Natoma streets, and was cut up into 41 subdivisions. The total receipts of the sale amounted to $200,725, which sum will be eventually returned to the shareholders in the shape of a cash dividend.

AT the annual meeting of the shareholders of the Mutual Gas Company, of St. Johns, Mich., the following officers were chosen: Directors, Jno. H. Corbit, Thomas Bromley, Jr., Chas. Fowler, Geo. F. Marvin, Geo. A. Wells; President, Chas. Fowler; Vice-President, Geo. F. Marvin; Secretary and Treasurer, Geo. A. Wells.

SUPT. FORSTALL, of the Lockport (N. Y.) Gas and Electric Company, is overhauling the main system, in order to reduce the leakage account.

THE capital stock of the Providence (Pa.) Gas and Water Company has been increased to $50,000.

MR. O. N. GULDLIN, President of the Western Gas Construction Company, informs us that the Company has just been awarded a contract for the construction of a second set of its apparatus by the Middletown Gas and Electric Light Company, of Middletown, N. Y. The apparatus will consist of the Western Company's improved type of double superheater setting, with engine, blower and oil feed system complete; also an additional charging floor. This contract will, in connection with the apparatus previously installed at Middletown by the Western Company, make a complete double set of its system in use there.

THE Directors of the Troy (N. Y.) Gas Company have declared a dividend of 2 per cent. for the quarter ending June 1st.

WE understand that the Brockport (N. Y.) Gas Light Company will extend its mains to and through the adjoining village of Holley.

MESSRS. DOREMUS & DAY have been awarded the contract for the construction of the new office building for the Newark (N. J.) Gas Company. The cost of the structure is put at $88,000.

AT the annual meeting of the Catasauqua (Pa.) Gas Company the officers chosen were: President, Edwin Thomas; Secretary and Treasurer, Edwin Jones.

THE Pittsburg Gas and Coke Company, of Philadelphia, Pa., has been incorporated by Messrs. Wm. L. Elkins, Jr., Thos. D. Finletter, Geo. T. Bears, Walter Cox and Arthur B. Eaton, all of Philadelphia.

THE plant of the Faribault (Minn.) Consolidated Gas and Electric Company will be changed from the coal system to that of water gas. It is also likely that a concession in the selling rate will be made.

AT the annual meeting of the shareholders in the Portland (Me.) Gas Light Company a dividend of $2.50 per share was declared, and the following officers were elected: Directors, Edward H. Daveis, William W. Thomas, William H. Moulton, Fred. N. Dow, Charles S. Fobes and Zenas Thompson; President, Edward H. Daveis; Treasurer, Samuel Rolfe. The following interesting report of the operations of the Company for the past year was submitted by President Daveis: "The consumption of gas for the year ending April 30th was 76,552,000 cubic feet, a gain of 7,339,200 cubic feet over the preceding year; 6,781 tons of coal have been used, and 117 tons of oil, yielding 85,914,000 cubic feet of gas, with an average illuminating power of nearly 20 candles. The loss of gas by leakage or otherwise not accounted for is about 11 per cent. The net income from sales of gas is $43,513.75, against $39,205 for the preceding year, when, owing to strikes, we had to use some inferior coal. The net income from sales of coke is $7,776.24, and from coal tar, $5,758.56, making in all $13,534.80, against $11,016 the preceding year. We have now 3,310 consumers, a gain of 119. We have sold 238 gas stoves during the year, making 608 now in use, and

1,362 Welsbach lights, making about 3,000 now in use. Sixty-three new service pipes have been put in, and 3,103 feet of new street mains have been laid on the following streets: Sherman, Oak, Crescent, Vesper, Neal, Beckett, Cumberland, Lewis, Taylor, Arsenal and Ellsworth. The principal repairs at the works have been in the renewal of the eight benches of retorts in the westerly section of the retort house, with regenerative furnaces and iron fronts, and a new iron floor, cost ing about $2,700. As a part of the labor is by our own men, it is not convenient to keep an exact account, nor is it important, as all such repairs are charged to profit and loss. For the current year, eight benches of six retorts are to be built in the easterly section of the retort house, in place of the benches of fives, which have given out. Some additional excavation has been found necessary to get a good foundation. The expense is estimated by our engineer at about $8,500. About 75 feet of the retort house wall on the northerly side has become un safe, owing to the settling of the foundation, and must be rebuilt. It will cost some $700, as the iron roof must be supported and the wall rebuilt a piece at a time. Our scrubbers and condensers were hardly sufficient for the maximum quantity of gas made per hour last winter. Our engineer is making investigations to ascertain the most approved kind, and in view of the probable increase in our output of gas, we may conclude to put in the new apparatus the coming fall. The cost, so far as inquiries have been made, is estimated at some $2,000. Owing to the comparatively small amount of expenditures for renewals at the works during the past year, and of some other ordinary expenses, the Directors have been able to declare the usual dividends, by taking $3,000 only from the profits of former years. And they have voted to reduce the price of gas from the 1st of July next to $1.50 per 1,000, with the same discount for prompt payment and the same rebates as heretofore."

The True Resistance of the Electric Arc.

At a meeting of the British Physical Society, held May 8th, a paper on the subject named in the heading was read by Messrs. Frith and Rogers. An abstract of the paper and discussion is appended:

It was pointed out by Professor Ayrton at the British Association meeting at Ipswich that if the "true resistance" of an arc is defined as the ratio of a small increase of the potential difference between the carbons to the corresponding change in the current, then it follows that this "true resistance" must be a negative quantity.

In order to measure the "true resistance" without appreciably altering the form of the carbons, etc., the authors superpose a small alternating current on the main continuous current. The arc lamp employed was adjusted by hand, and the arc length was measured by projecting an image of the arc by means of a lens. The main (continuous) current and potential difference were measured by a Weston ammeter and voltmeter, while the auxiliary alternating current was measured by means of an air transformer and an electrostatic voltmeter.

The authors find that between the limits employed the magnitude of the alternating current did not influence the results obtained for the resistance of the arc. The frequency, so long as it lies between the limits 250—7 complete alternations per second, and the wave form do not influence the resistance, since the same results were obtained with a Pyke and Harris alternator, a Ferranti alternator, a Gramme alternator, and a Mordey transformer.

For each make of carbon examined four combinations were used: + cored, — cored; + cored, — solid; + solid, — cored; + solid, — solid. The general character of the the curves obtained is that for the + solid, — solid combination, the "true resistance" is always negative, while for + cored, — cored it is always positive, the other curves being between these two extremes, those which have the + carbon solid always being more negative than those which have the + carbon cored.

In the case of the curves showing, for solid carbons, the relation between the resistance of the arc and the potential difference between the carbons, the current being constant (10 amperes), a minimum (maximum negative) value for the resistance occurs at about 55 volts. With combinations having a cored positive, this minimum becomes more strongly marked, and occurs at a lower voltage. The authors find that for cored carbons the position of this minimum is closely connected with the presence or absence of the dark space in the arc. For points on the curve to the right of the minimum point, the dark space is absent, while for points to the left of the minimum the dark space is always present.

It was found that the effect of using as the + carbon a Carré carbon in which the core had been bored out, was to obtain a curve closely resembling that obtained when both carbons were solid. On filling this hollow carbon with plaster of Paris or kaolin, the resistance of the arc became positive.

The above experiments were made with the + carbon uppermost. Other experiments made with the arc inverted showed that with solid carbons the resistance is not appreciably altered by inverting the arc. With cored carbons, however, the resistance, as well as the physical character of the arc, is altered, for on inversion the dark space disappears, and the resistance considerably diminishes. If, however, the conditions under which the arc is burning are such that the dark space is absent, then inverting the arc does not alter the resistance.

Attempts were made to measure the "true resistance" of a direct current hissing arc, but it was found that even with the alternator at rest there was a large deflection of the electrometer, showing that the current through a hissing arc was oscillatory.

In order to elucidate the marked difference between their results for cored carbons and those deduced from Mrs. Ayrton's curves, the authors have made a series of measurements at low frequencies. They find that there is a critical frequency above which the resistance has a positive value which is independent of the frequency, and below which it has a negative value, this critical frequency being between 75 and 0 In order to investigate the sign of the resistance at low frequencies, the vibrations of the needles of the ammeter and voltmeter were made use of. By an arrangement of mirrors the needles and scales of both instruments could be observed simultaneously. In this way it could be seen whether the two needles were, at any instant, vibrating in the same or in opposite directions. If the needles vibrate in the same phase, *i. e.*, if an increase of potential difference is accompanied by an increase of current, then the resistance must be positive, while if they are vibrating out of phase, *i. e.*, if an increase of potential difference is accompanied by a decrease in current, then the resistance is negative.

An attempt to run the arc off a continuous current dynamo failed, since even with the alternator at rest the electrometer showed a large deflection, evidently due to the oscillation of the current owing to the commutator of the dynamo having a finite number of segments.

Professor A. Gray doubted whether it was right to give the name "true resistance" of the arc to the slope of the curve connecting the potential difference (V) and the current (A). The author's method of deducing $\frac{\delta V}{\delta A}$ was only true if the curve was a straight line, while in the case of the arc E and a may both vary with the current.

Mrs. Ayrton said that with reference to the question of the existence of a back electromotive force the evidence tended to show that it did not exist. By using an exploring carbon no constant back electromotive force could be found.

Professor Ayrton said that, considering the arc as consisting of a back electromotive force and a resistance, it was necessary to separate these two. Simply obtaining one value of the potential difference and the current was of no assistance in solving this question, but a series of values had to be taken. By taking the change in potential difference and current sufficiently small, the curve over the range considered was practically straight. It was curious to note that as long as observers obtained a positive value for the resistance of the arc, no fault was found with the method, but now that a negative value was found the accuracy of this method was questioned. If a back electromotive force does really exist, then it follows that the arc must have a negative resistance. Mr. Frith has shown why some people have got positive and some negative values for the resistance of the arc, and also that with an alternating current you may get one or the other.

Mr. T. Carter asked if the fact that the arc had a negative resistance did not imply a back electromotive force, in order that the arc might be stable. If so, was a negative resistance such an absurdity?

Mr. Campbell said he was very pleased to see that the authors had applied a method which he (Mr. Campbell) had suggested for measuring pulsating currents. If a pulsating current, such as could be obtained by means of a make and break, is passed through a thermopile, you would get a back electromotive force; while if an alternating current were employed, you would not.

Mr. Frith, in his reply, said that he had defined the "true resistance" as $\frac{d V}{d A}$. Mrs. Ayrton has shown that an arc will not run unless a certain resistance is placed in series with it; this resistance must be numerically equal to the negative resistance of the arc itself.

Professor Ayrton said Mr. Frith's remarks as to the cause of the want of stability of an arc without outside resistance were most suggestive.

The Chairman (Captain Abney) said he did not like the expression "potential difference." He suggested the employment of photography to facilitate the accurate registration of the instrument readings.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO., PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE.

TERMS:
SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

AGENTS:
New York—American News Co., 39 and 41 Chambers St.
Germany—B. Westermann & Co., of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JUNE 1, 1896.

The Market for Gas Securities.

The "short side" had things pretty much all its own way in making quotations for city gas shares this week; but evidences appear to multiply that the "longs" are about to take an inning, notably in Consolidated, the dividend on which for the last quarter will be declared to-day (Friday.) The stock opened at 156 bid, and closed at 158 bid, offered at 158½. Other city shares are weak and uncertain, Equitable being offered at 212, and Mutual at 235. The Consumers bugaboo, which is now before the Board of Aldermen, is not worthy of serious consideration, so far as its effect on the value of existing shares is concerned.

Brooklyn Union is weaker, at 91½ to 92½, ex-dividend. Chicago gas is dull, at 67⅝, and Bay States and Lacledes are also lower. Laclede common is offered at 24, the final break being occasioned through an announcement of serious losses to the Company because of the frightful storm in St. Louis last Wednesday. Consolidated, of Baltimore, is offered at 63¼.

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DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, May 14, 1896.

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable on June 10, 1896, to stockholders of record at the close of business May 29, 1896. Transfer books of the preferred stock will be closed from May 30 to June 10, both inclusive. Checks will be mailed.

1094-3 EDWARD C. LEE, Treasurer.

Position Wanted

Experienced man desires position as Superintendent of Gas Works or Gas and Water Works combined, or Gas and Electric Light Works combined, or separate construction of either. Supt. of combined plants nearly 7 years. Twenty-five years' practical experience. First-class references.

Address "G. H. H.," 3222 Pacific Avenue,
1095-3 Tacoma, Wash.

WANTED,

By a young man of 30 years' experience, a position to take full charge of gas works, or Superintendent of manufacturing and distribution. Coal gas works preferred, especially where regenerative benches are in use or can be introduced. All-round man in all branches of the business. Have sold 30 gas ranges so far this season; 500 Welsbach lights now in use in town of 15,000 population. Competent and reliable references as to ability and character. Salary reasonable. Best of reasons for desiring a change. Address

1095-4 "T. H. S.," care this Journal.

Position Desired

With a Small Gas Company

By a man 30 years old, experienced in all departments, competent and reliable. Has managed works with output of 50,000 per day. Could invest small amount. Opportunity to give good service is desired; salary is secondary.

1095-1 Address Box 392, Somerville, N. J.

WANTED,

A Competent Man to Operate Water Gas Plant, Lowe Style.

State wages, with references,

"O. G.," 703 Girard Building,
1093-3 Phila., Pa.

Position Wanted

As Superintendent of Gas Works or Gas and Electric Light Works.

Has been in the employ of the Long Branch (N. J.) Lighting Company as Superintendent for the last 11 years, and is a practical mechanic, thoroughly understanding the laying out and erection of plant and the making of coal and water gas. Best of references. Address CHAS. J. LUTHER,

1095-2 Box 142, Long Branch, N. J.

Position Wanted

As Superintendent of Gas Works.

Has been in the employ of the Passaic (N. J.) Gas Company for the last 10 years as Superintendent, and is a practical mechanic, thoroughly understanding the laying out and erection of plants and the making of coal and water gas. Seventeen years' experience as constructor and builder with John Hanlon, Gas Engineer. Best of references. Address

1096-10 FRANK JONES, Passaic, N. J.

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Two No. 2 Baker Blowers, in first-class condition; one nearly new.

A Snell & Meharg 25 H.P. Horizontal Engine, in good condition.

A Westinghouse Automatic Engine, 25 H.P., 7½ x 7, which needs some new parts. Can be seen in operation at the Works of the

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BEAR CREEK CANNEL COAL

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NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

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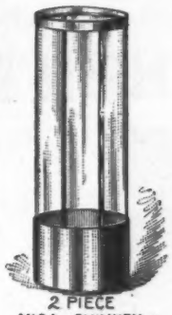
Special Agent for Selling & Purchasing.

Our Mica Chimneys



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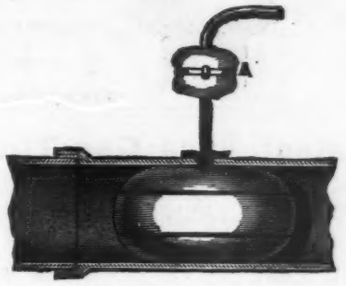
Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4 "	"	"	.80	16 "	"	"	8.25
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6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

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Made in all sizes.

Will cut from 2 in. to 24 in.

Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.

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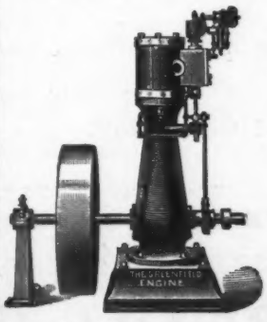

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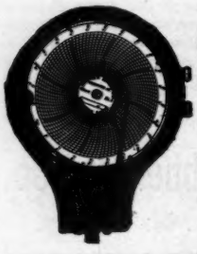
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COKE CARS for Gas Works,
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CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.
INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
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AMERICAN GAS COMPANY,
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Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.
The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.
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MANUFACTURERS OF

Detroit Jewel Gas Stoves.

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Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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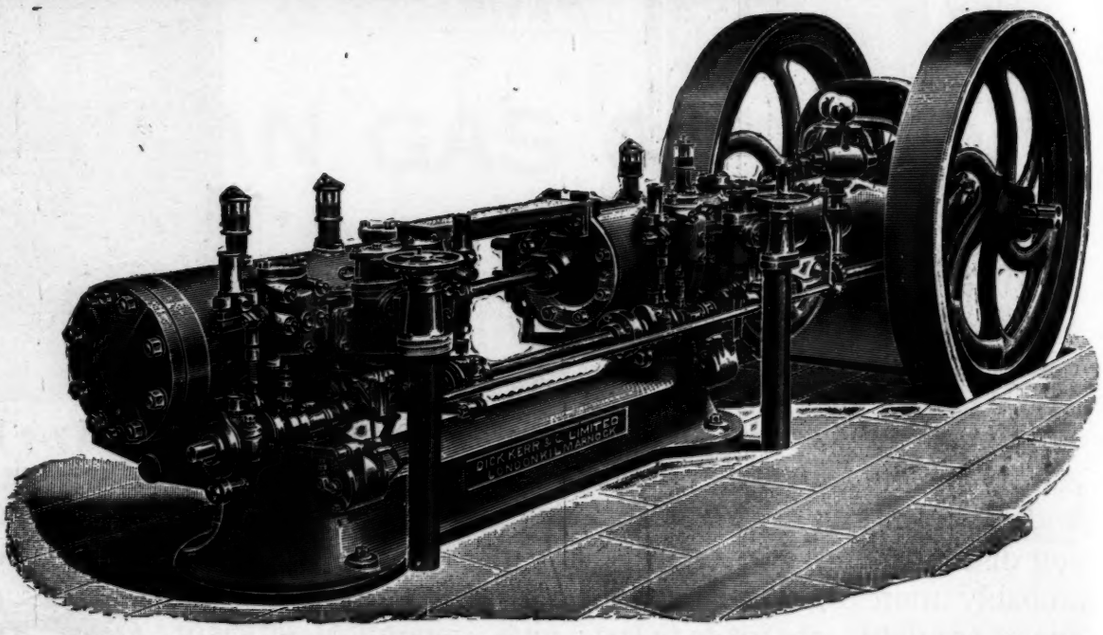
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



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No. 34 Light, with No. 10 and No. 43 Opal Shade.

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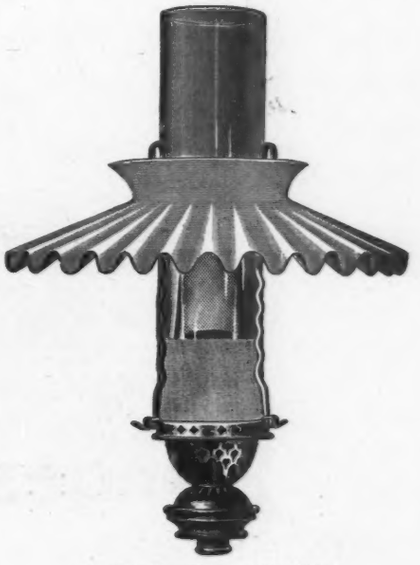
CAUTION!!

Persons dealing in counterfeit lights are liable to criminal prosecution, and a large number of indictments have already been found against such dealers.

All infringements of this Company's patents will be promptly and vigorously prosecuted, dealers and users being equally liable. This Company will prosecute all parties in whose possession infringing lights are found.

This notice is given in view of an effort now being made to introduce into this country infringing lights made in Germany, the sale of which, there, has been prohibited by the recent decision of the German Patent Office sustaining the validity of the Welsbach patents.

For your own protection, see that you get the genuine Welsbach light, as both the counterfeit and the infringing lights are greatly inferior.



No. 34 Light, with No. 74 Opal Shade.

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We Make Everything in the Line of Gas Appliances.

THE VULCAN FAMILY RANGE.

Elevated Broiler, Improved Burners with Adjustable Gas Injectors and Air Mixers.

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With largely increased facilities in our new factory, just completed, and the control of many valuable patents, we are thoroughly equipped to meet every want in the line of Gas Appliances for heating, cooking and manufacturing purposes.

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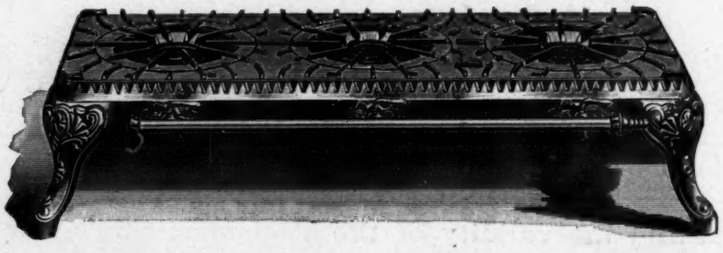
Convenient, Effective, Economical and Cheap



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The Keystone Burner will do the most hard work in the briefest time, and use every cubic inch of gas consumed to the best advantage. Write us about it. Grade high. Price low. Appearance æsthetic. Sales quick and sure.

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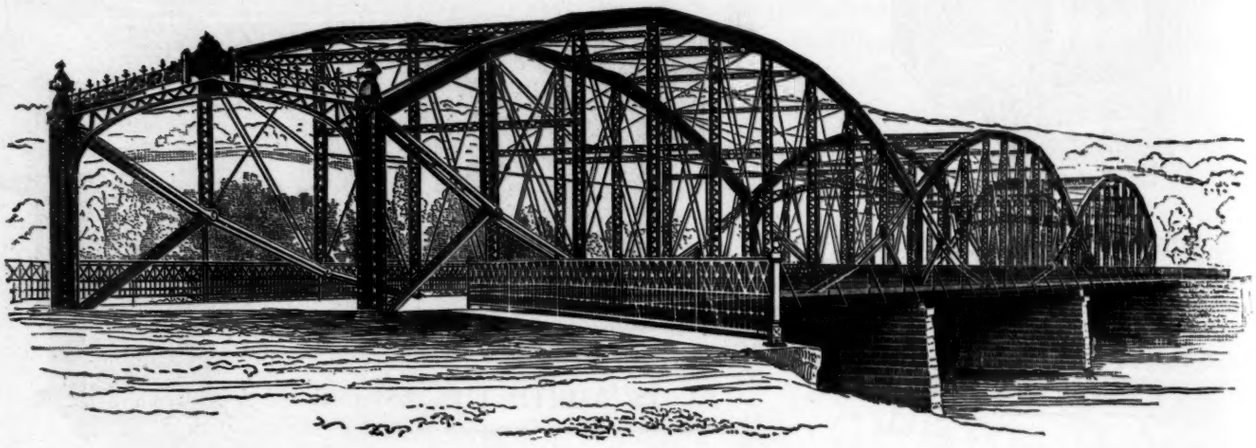

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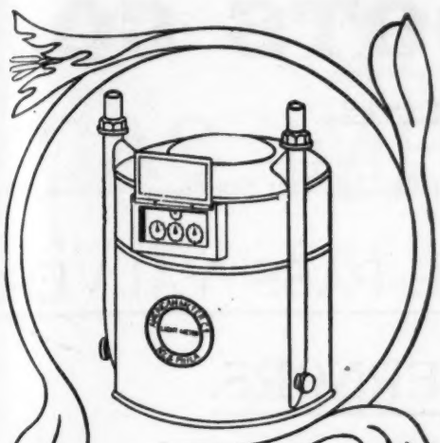

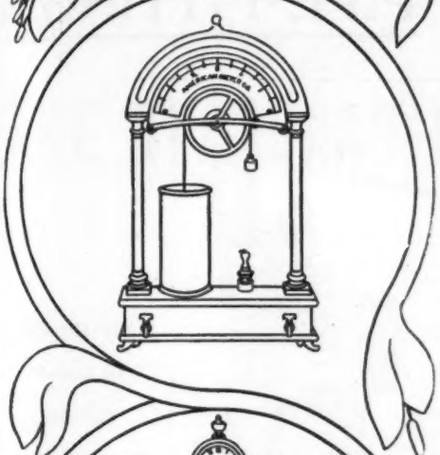

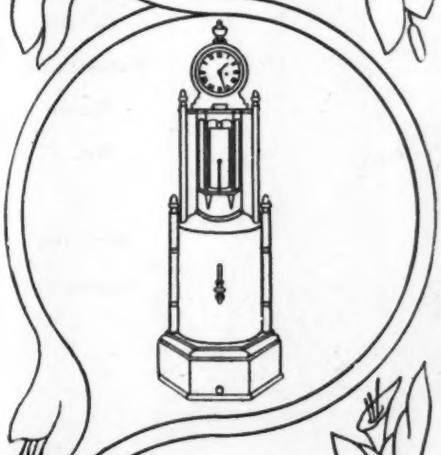

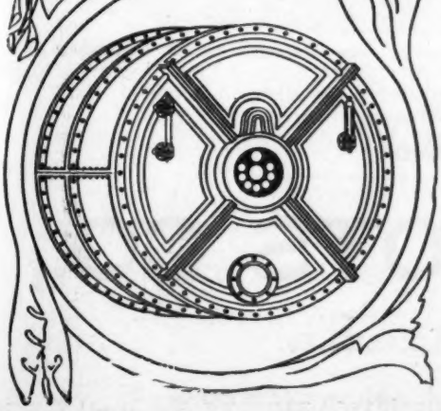

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SAN FRANCISCO.

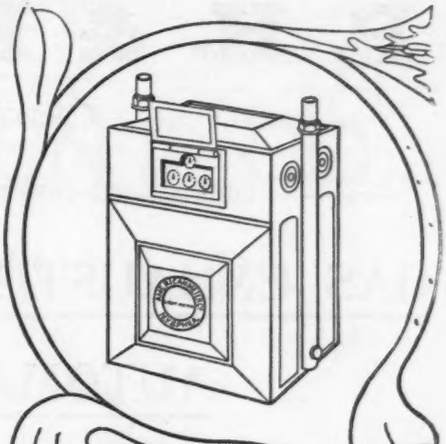
PUBLIC LIGHTING TABLE.

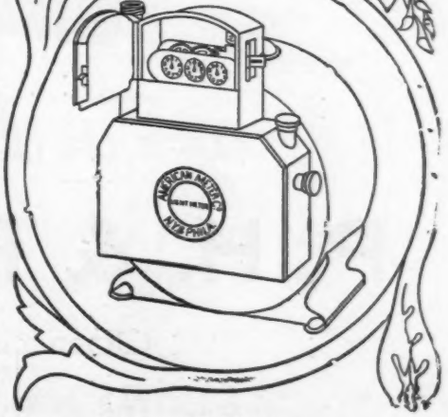
JUNE, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	7.50 PM	1.00 AM	7.15	3.15
Tue.	2	7.50 LQ	1.20	7.15	3.15
Wed.	3	7.50	1.40	7.15	3.15
Thu.	4	7.50	2.00	7.25	3.15
Fri.	5	7.50	2.20	7.25	3.15
Sat.	6	7.50	2.50	7.25	3.15
Sun.	7	8.00	3.30	7.25	3.15
Mon.	8	8.00	3.30	7.25	3.15
Tue.	9	8.00	3.30	7.25	3.15
Wed.	10	8.00 NM	3.30	7.25	3.15
Thu.	11	8.00	3.30	7.25	3.15
Fri.	12	8.00	3.30	7.25	3.15
Sat.	13	8.00	3.30	7.25	3.15
Sun.	14	8.00	3.30	7.25	3.15
Mon.	15	10.00	3.30	7.25	3.15
Tue.	16	10.20	3.30	7.25	3.15
Wed.	17	10.50 FQ	3.30	7.25	3.15
Thu.	18	11.10	3.30	7.30	3.15
Fri.	19	11.40	3.30	7.30	3.15
Sat.	20	12.10 AM	3.30	7.30	3.15
Sun.	21	12.50	3.30	7.30	3.15
Mon.	22	1.30	3.30	7.30	3.15
Tue.	23	No L.	No L.	7.30	3.15
Wed.	24	No L. FM	No L.	7.30	3.15
Thu.	25	No L.	No L.	7.30	3.15
Fri.	26	8.00 PM	10.00 PM	7.30	3.15
Sat.	27	8.00	10.30	7.30	3.15
Sun.	28	8.00	11.00	7.30	3.15
Mon.	29	8.00	11.20	7.30	3.15
Tue.	30	8.00	11.40	7.30	3.15

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00





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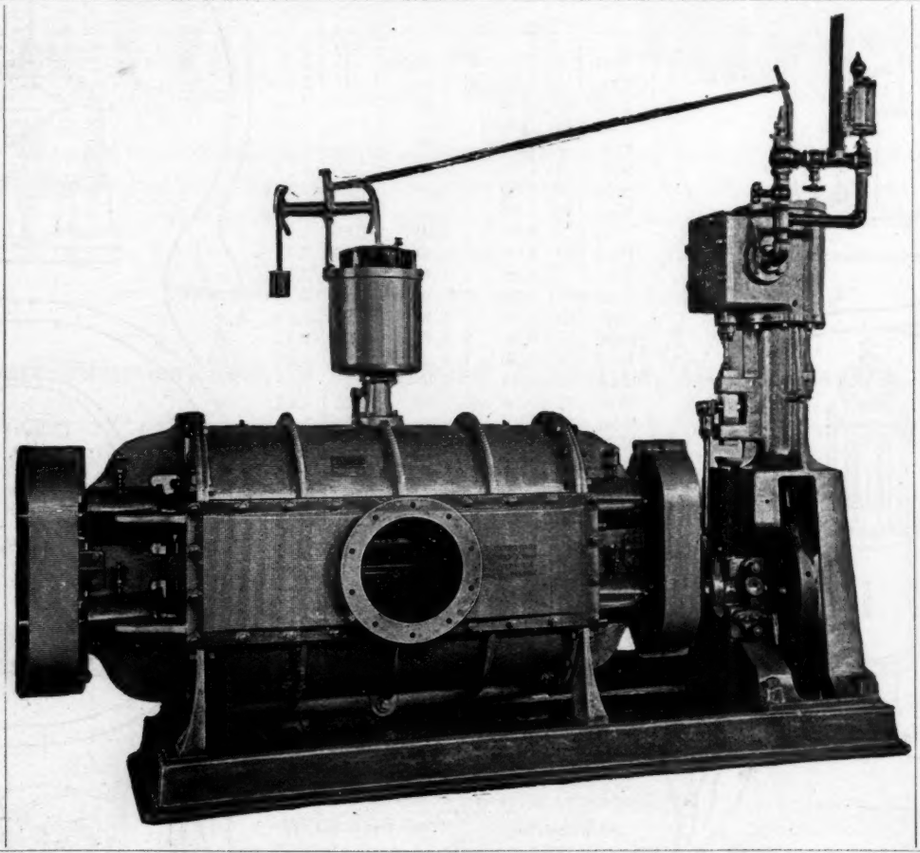

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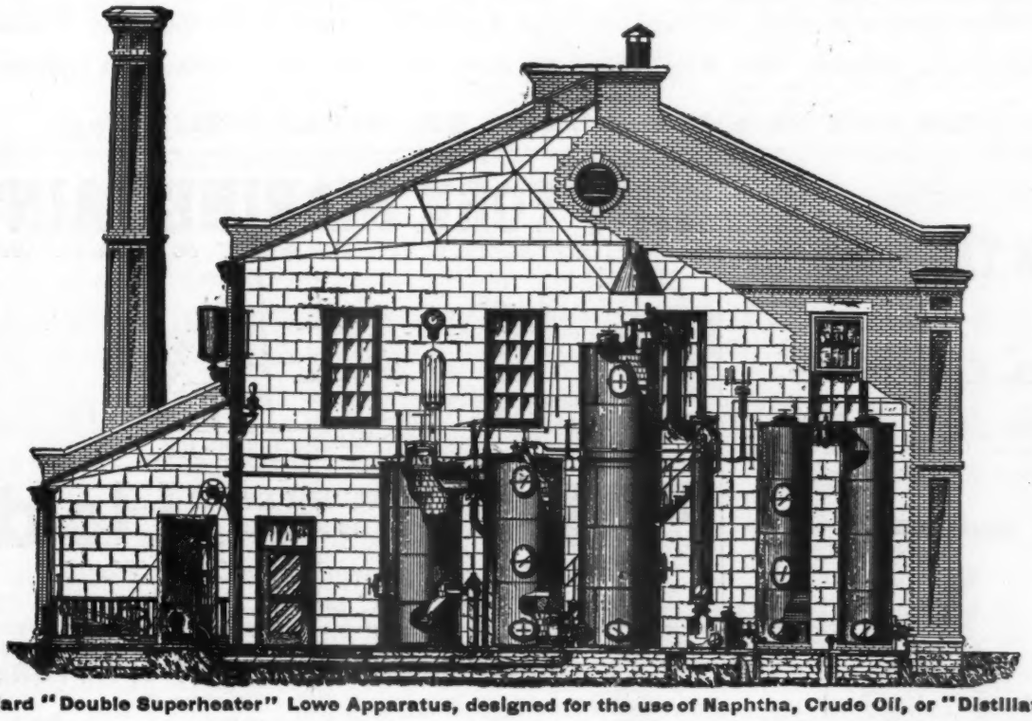

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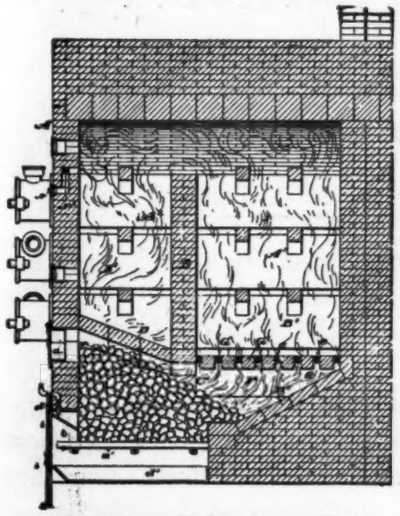

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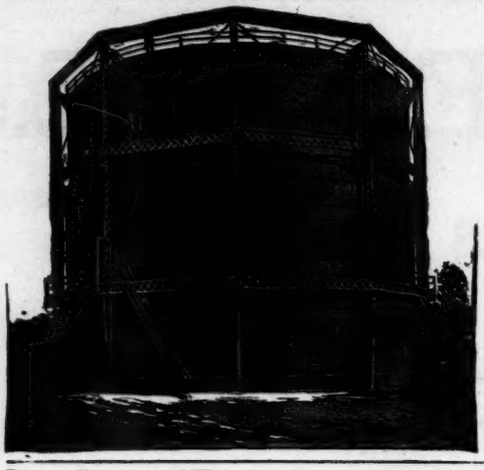

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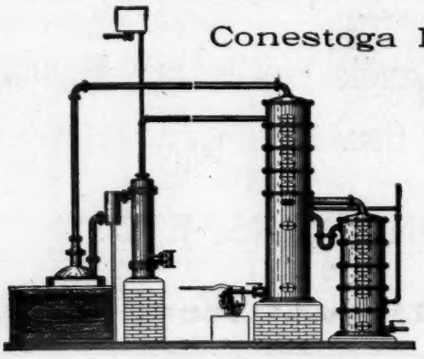

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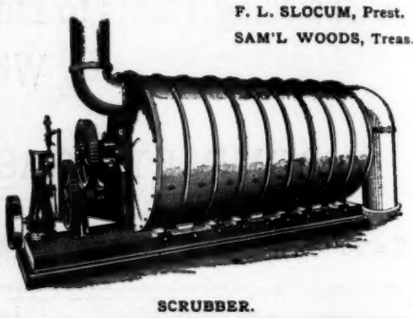

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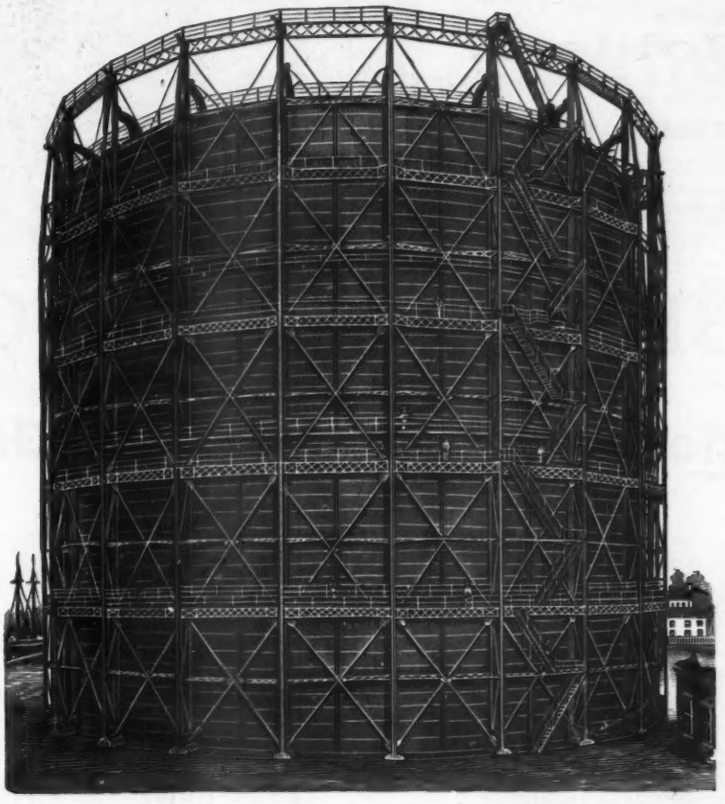

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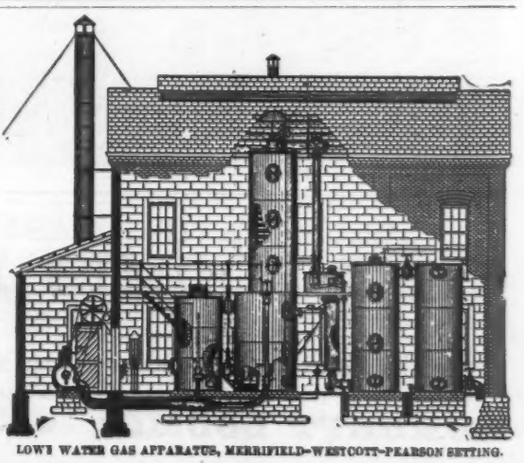

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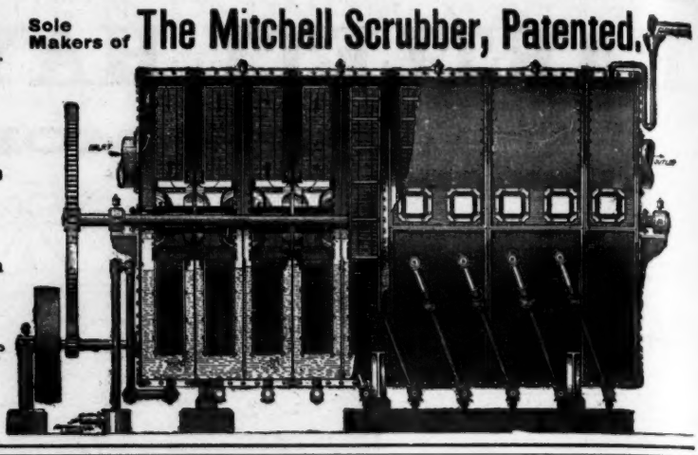

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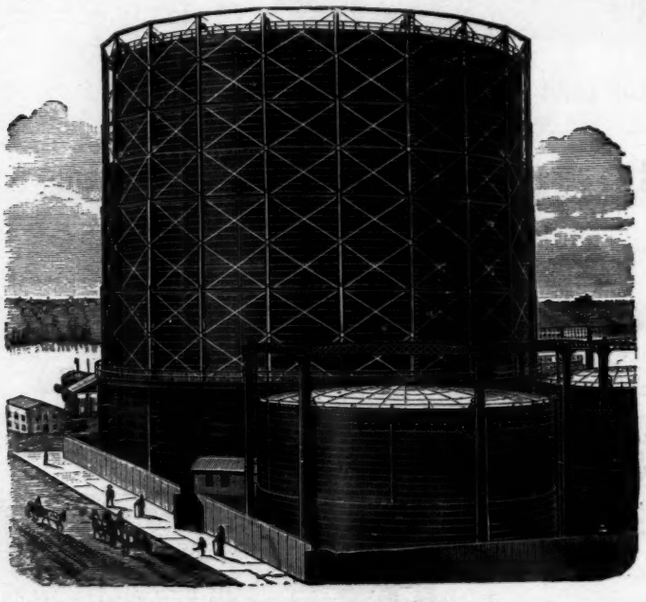

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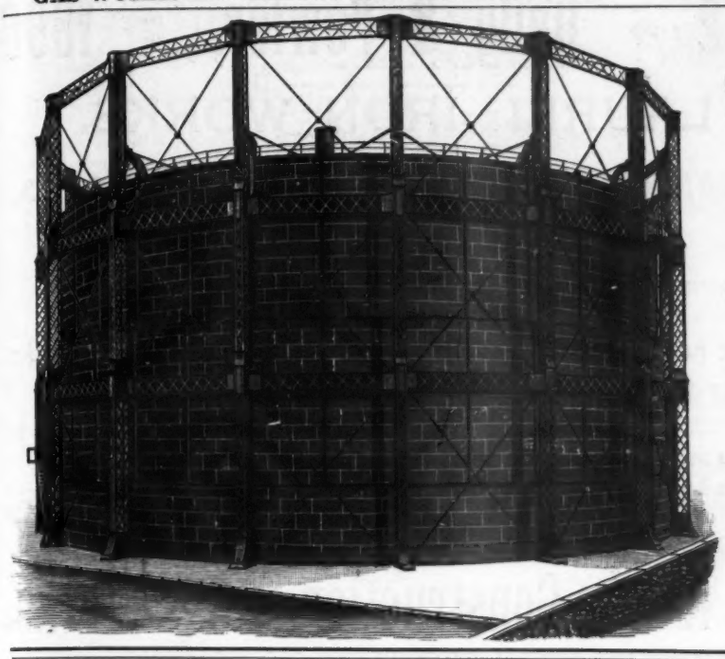

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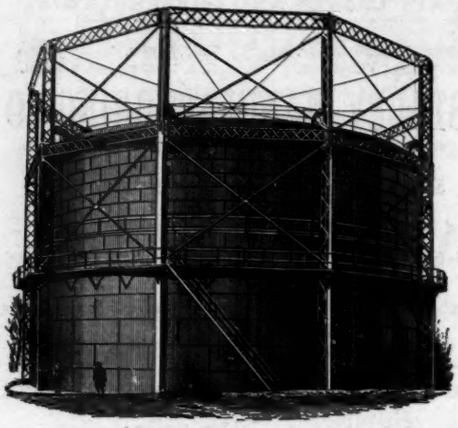

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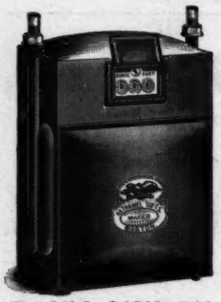

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